VOL. XII Nº 2 FEBRUARY 1927

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(See page 98)

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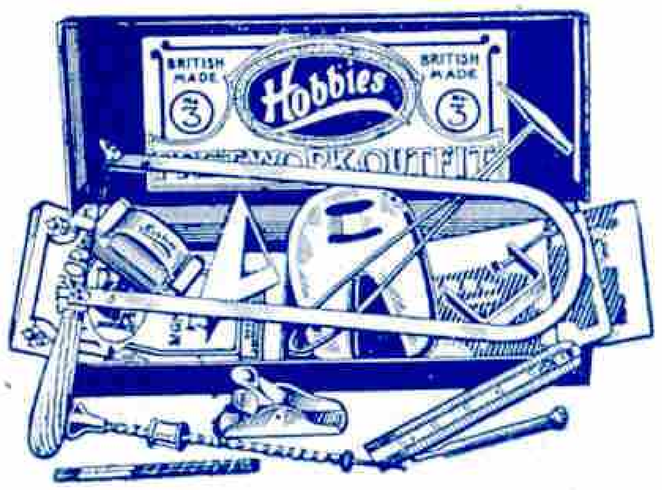

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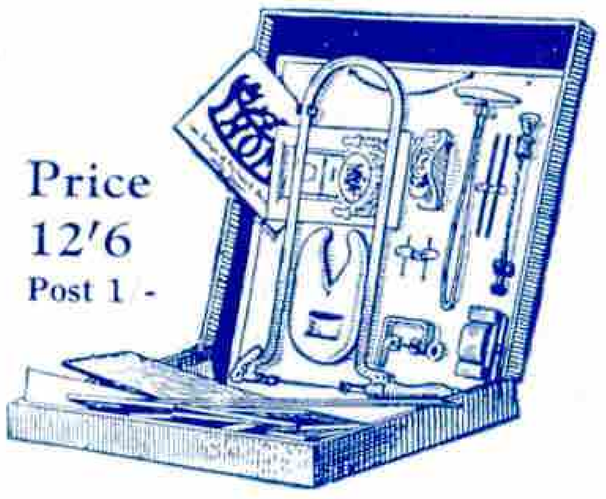

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MECCANO MAGAZINE

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Liverpool

Vol. XII. No. 2
February, 1927

With the Editor

A Notable Event in 1927

One of the most wonderful sights of modern times will be seen this year on the 29th June, when there will be a total eclipse of the Sun visible from England. Such an event has not taken place since 1724 and will not occur again until 1999! The eclipse will be visible from a strip of country about 30 miles in width, along a line that stretches from Carnarvonshire to Durham and north Yorkshire. The most impressive spectacle that the heavens can show will occur when, for nearly half-a-minute, the Sun will be blotted out and the glories of the Sun's corona may be seen spread out for millions of miles across the darkened sky. Other phenomena will be visible—stars will be seen, and possibly some of the planets.

The eclipse is a sight of historical importance that should be witnessed by everybody who can possibly take up his or her station in the area of totality. Many will travel from all parts to the favoured places and arrangements are being made by the railway companies to run a specially-augmented train service. Already accommodation in towns and villages along the line of totality is rapidly being booked up.

This note is simply a preliminary announcement and intended to assure my readers that full preparations are being made to give them all particulars of the eclipse, so that they may rely upon being fully catered for in connection with this extraordinary event. A series of articles is now in hand describing exactly what will be seen, and special maps will show the best places to which to go. So accurately have astronomers measured the heavenly bodies and calculated their distances and rates of movement that it is possible to foretell the commencement of an eclipse to within a few seconds for any given place.

The only thing that remains to make the eclipse a success is that the morning should be fine, and the sky clear. Unfortunately we cannot guarantee this, and can only hope that the Clerk of the Weather will be kind to us. To those who are not early risers it will come as sad news that the eclipse takes place at 6.30 a.m.! Perhaps on this auspicious occasion they may be persuaded for once in a while to get up with the lark, however—more especially as they may rely upon not being called upon to do so again in similar circumstances for at least 72 years!

Engineering on the Moors

Every year I endeavour to devote at least a few days to a walking "tour"—there is no healthier form of exercise—and it is rather strange how I generally come across something of engineering interest. For instance, last year one of my walks was from Newcastle to Carlisle, along the Roman Wall, which is a mighty tribute to the engineering abilities of the Romans. Curious bridges; a hydro-electric scheme and its wonderful pipe lines; and an aerial railway are some of the other engineering subjects that I have encountered in recent walks.

Last autumn I had an enjoyable walk on some of the wildest of the Yorkshire Moors. One morning, having surmounted a high ridge, I was surprised to see at my feet a stupendous engineering achievement in the process of being carried out. Here in this quiet valley is being constructed a huge dam which, when completed, will be the highest dam in Great Britain and probably the highest in the world. Scar House Dam, as it will be called, will be 267 ft. in height and 1,800 ft. in length and will cost over £2,000,000. Although work was commenced five years ago, it is not expected that the dam will be finished until 1933!

A Chain of Reservoirs

As I stood on that wild moorland ridge and looked down upon the busy scene below, I felt like the famous Gulliver, for the hundreds of men hard at work, obtaining stone from the hillside above the dam, looked like an army of Lilliputians. The latest engineering appliances were being used to place innumerable seven-ton blocks of stone in the masonry concrete of the dam. At the same time, large quantities of stone were being quarried and taken by hundreds of miniature trucks to the concrete mixing machines in the valley below, where the crushing plant has a capacity of two tons a minute. The trucks were hauled by numerous locomotives whose small size was adequately set off by their air of busy importance! The screeching of countless shrill whistles, and the roar of half-a-dozen trains under way reminded me at once of a wonderful Hornby Train system.

Scar House Dam will form a reservoir that will be the largest of a chain of three reservoirs in the Nidd Valley, the purpose of which is to supply Bradford with water. It is estimated that when the scheme is completed the city will have a water-supply that will meet its requirements for the next 70 years.

A walk further up the valley brought me to Angram, the first of the chain of reservoirs, where I stood for some time on the completed dam, a solid wall of masonry that has turned a peaceful valley into a huge lake. Although it seems a matter for regret that it should be necessary to construct these artificial lakes and so flood the beautiful valleys, the growth of our great cities, and the consequent increasing demands of their inhabitants, are the inevitable penalties of national progress. Sacrifices must be made by the few for the comfort and health of the many.

The Challenge of Oil to Steam

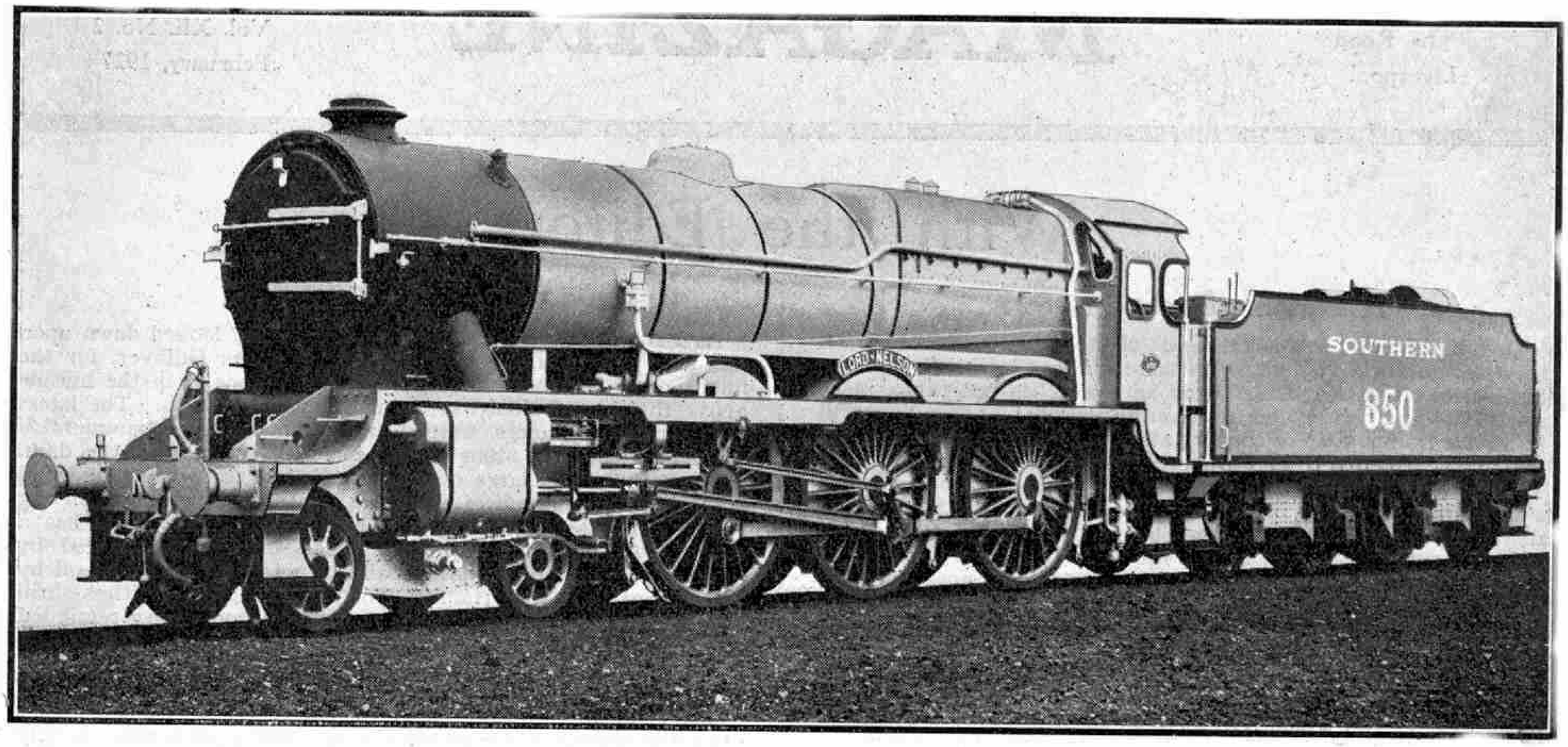
In the article in our October issue dealing with the motorship "*Gripsholm*," particulars were given of the coming fight between oil and steam. It was mentioned that oil engines for marine purposes are rapidly increasing in number, and that soon they will seriously threaten the steam engine. The annual report recently issued from Lloyd's Register of Shipping, discloses that during the 12 months ending last June, 26 vessels of more than 8,000 tons displacement, fitted with oil engines, were registered. The total number registered up to the end of the previous year was only 19. During the year plans were passed for 361 new ships of a total tonnage of 1,089,360. Of these 113 vessels are to be fitted with internal combustion engines, their gross tonnage being 601,427. An interesting sidelight on the growth of the use of internal combustion engines is revealed by the fact that 43 ships of a total of nearly 300,000 tons were registered as vessels intended for carrying oil in bulk.

These figures show, to some extent, that oil is seriously challenging steam on the high seas, but already the challenge has been taken up by the designers of modern steam engines, who are giving considerable attention to the question of improving the efficiency of the steam engine so that it will compete successfully with the Diesel-type marine engine. It is anticipated that these developments will result in showing an even greater economy in fuel consumption than that shown by the oil engine.

In this connection, a few months ago a new turbine steamer, "*King George V.*" was launched at Dumbarton. This ship embodies machinery with some outstanding features of interest, the principal of which is the high steam pressure used—namely, from 500 to 550 lbs. per square inch.

Britain's Most Powerful Loco

For Express Passenger Traffic:—The "*Lord Nelson*"



IN order to cope with the steadily increasing weight of express passenger traffic on the Southern Railway, a new locomotive, designed by Mr. R. E. L. Maunsell, Chief Mechanical Engineer for the Southern Railway, has been built at the Eastleigh, Hants, locomotive works. This engine is No. 850E, named "*Lord Nelson*," and is the first of a new series of 4–6–0 four-cylinder simple superheater engines with double bogie tenders, slightly heavier and possessing more power than the famous "King Arthur" class. The new type will be known as the "Nelson" class.

The "*Lord Nelson*" has been built to haul trains of 500 tons at an average speed of 55 miles per hour, but since the heaviest passenger trains on the Southern Railway at present rarely exceed 450 tons, the locomotive will possess considerable reserve power.

Remarkable Increase in Power

Most of our readers will be aware that some two years ago Mr. Maunsell conducted a number of experiments with one of the Drummond four-cylinder engines, No. 449. This engine had two inside and two outside cylinders, whose drive was divided between two axles, the angle of the cranks being arranged to give four impulses per revolution. In the experiments mentioned the drive was re-arranged to turn the cranks of the inside engine through 45° and the wheels were re-balanced to suit this arrangement, which resulted in eight separate impulses being given in each revolution.

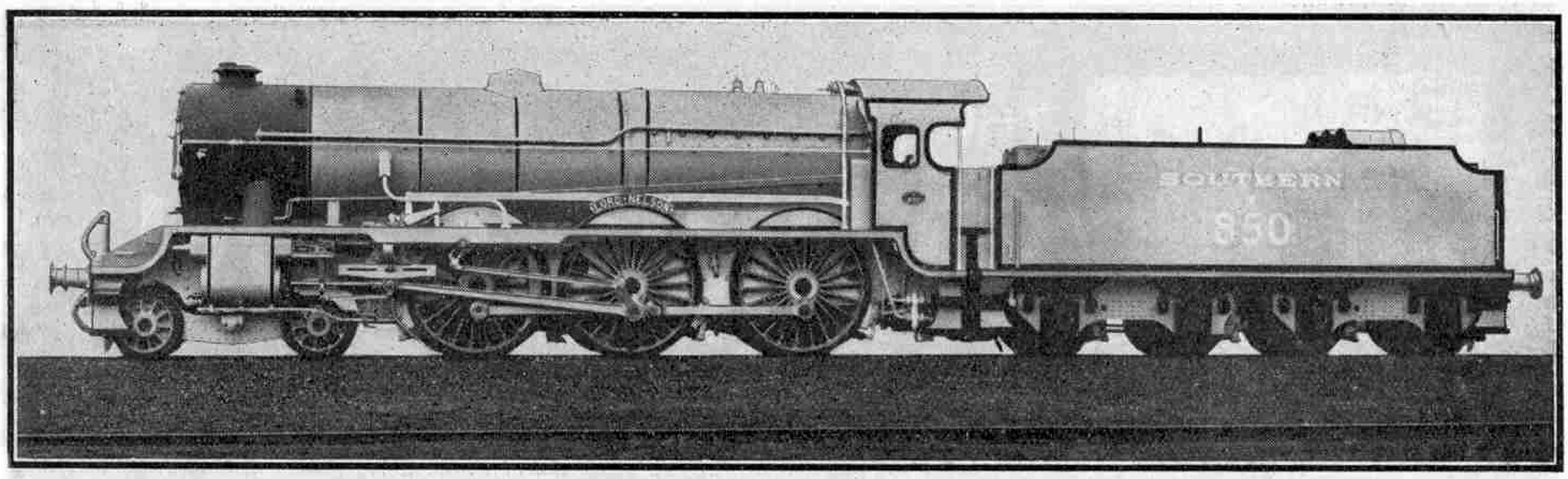
The increase in power secured by this alteration was so remarkable that a similar order of cranks which, for reference purposes, can be termed the 135° arrangement, has been embodied in the "*Lord Nelson*." In this case, while the crank pins on each of the two driving axles are placed at 90°, one pair is arranged 135° in advance of the second pair. Thus are the eight equally-spaced exhaust impulses secured. The remarkable effect of this arrangement upon the steaming power of the boiler has made it necessary to enlarge the blast nozzle in three successive steps.

Boiler barrel	
Outside diameter at fire-box ...	5 ft. 9 in.
Length	13 ft. 9 in.
Length between tube plates ...	14 ft. 2 in.
Fire-box shell	
Width	4 ft. 0½ in.
Length	10 ft. 6 in.
Heating Surface	
Fire-box	194 sq. ft.
Small tubes	1,282 sq. ft.
Large tubes	513 sq. ft.
Total	1,989 sq. ft.
Superheater surface	376 sq. ft.
Grate area	33 sq. ft.
Cylinders ... (four) 16½ in. dia. by 26 in. stroke	
Coupled wheels	6 ft. 7 in. dia.
Bogie wheels	3 ft. 1 in. dia.
Tractive effort at 85 per cent. boiler pressure	14.95 tons
Weight of engine in working order	83 tons 10 cwt.
Weight of tender in working order	...56 tons 14 cwt.
Total weight	...140 tons 4 cwt.

Special Skill for Reciprocating Parts

Walschaerts' valve gear is employed for both inside and outside cylinders and the revolving and reciprocating parts have been made extremely light by the use of a special high-tensile steel known as "*Vibrac.*" This patent steel is manufactured by Sir W. G. Armstrong Whitworth & Co. Ltd., and is of the nickel-chromium class, its specially high quality being obtained by substituting molybdenum for a portion of the chromium. The comparative lightness of the balance weights used on the wheels is, of course, a resultant advantage, and the use of this special steel will be watched with considerable interest by all locomotive engineers.

The fire-box is of the Belpaire pattern—a new feature



Side view of the new Southern Railway Locomotive No. 850, "*Lord Nelson*"

for engines built at Eastleigh—and is of extremely liberal proportions. The fire-box stays are of steel in the fire area and ordinary riveted copper in the other parts. The tubes are of moderate length, there being 173 small tubes each of 2 in. external diameter, and 27 large tubes of 5¼ in. external diameter. The superheater header is of the Maunsell type, with air relief valves, while safety valves of the Ross patent "pop" type are mounted above the fire-box. Included among the other fittings are a soot blower, exhaust injector, and a four-feed sight-feed lubricator with a separate condenser for the cylinders and valve chests.

Brakes Act on Tender's Wheels

The cab follows generally the design of Mr. Maunsell's latest 4–4–0 type engine cabs and has side windows of glass and tip-up seats for the driver and fireman. All the controls are arranged so that they can be reached with a minimum of effort. The double bogie tender is similar to that used with the "King Arthur" engines with the exception that it has straight flat sides with no overhanging coping. It has a capacity for 5,000 gallons of water and five tons of coal. The three steel cylinders that are just discernible in the illustrations at the rear of the tender are auxiliary reservoirs used in connection with the automatic vacuum brake and are specially connected to act on the tender wheels.

The overall dimensions of the "*Lord Nelson*" permit of its being worked on any main line section of the Southern Railway, and the leading particulars are as shown in the accompanying table.

"Castles" and "Pacifics" Surpassed !

When it is recalled that the complete weight of the King Arthur" class engine with tender is only 34 cwt. less than that of the "*Lord Nelson,*" it will be seen that the considerable increase in power has been achieved only by close attention to detail. The tractive effort, 33,500 lb. (14.96 tons), is calculated on the usual basis of 85 per cent. of the boiler pressure and is greater than that of either the G.W. "Castle" engines or the L.N.E.R. Pacifics, the tractive efforts of which are 14.12 and 13.32 tons respectively. The "King Arthurs" on the Southern Railway have a tractive effort of 11.31 tons.

The "*Lord Nelson*" has already worked the Waterloo-Bournemouth and "Atlantic Coast" expresses and at present is being tried on the Eastern Section's Continental service, being temporarily stationed at Nine Elms, where it has been fitted with a shelter for indicating purposes.

Miles			Schedule min.	Actual Times min.	Actual Times sec.	Speeds Noted m.p.h.	Notes
0.0	Salisbury	dep.	0	0	0	—	8½ min. late
1.1	Tunnel Jctn. ...	pass	—	4	14	38	
5.5	Porton	,,	—	11	20	37	At top of 1 in 140
8.1	Amesbury Jctn. ...	,,	—	15	20	41½	At top of 1 in 245
11.0	Grateley	,,	—	19	5	50	At summit
17.4	Andover	,,	22	24	45	74	11¼ min. late
21.3	Mile-post 62½ ...	,,	—	28	15	59	
22.6	Hurstbourne ...	,,	—	29	30	66	
24.5	Whitchurch ...	,,	—	31	20	61	
28.1	Overton	,,	—	34	55	60	
31.3	Oakley	,,	—	38	5	60	
33.4	Worting Jctn. ...	,,	39	40	5	—	9½ min. late
35.9	Basingstoke ...	,,	41½	42	10	75	9¼ min. late
36.7	Barton Mill ...	,,	—	—	—	77½	
41.5	Hook	,,	—	46	40	71½	
43.9	Winchfield ...	,,	—	48	35	—	
47.2	Fleet	,,	—	51	15	77½	
50.5	Farnborough ...	,,	—	54	0	—	
51 5	Sturt Lane Jctn.	,,	—	54	55	—	
52.8	Mile-post 31 ...	,,	—	56	0	69	
55.7	Brookwood ...	,,	—	58	20	76½	
59.4	Woking	,,	62½	61	15	80½	7¼ min. late
62.1	Byfleet	,,	—	63	20	79	
64.6	Weybridge ...	,,	—	65	20	71½	
66.7	Walton	,,	—	67	5	71½	
69.4	Esher	,,	—	69	20	71½	Engine 'eased' here
70.5	Hampton Ct. Jctn.	,,	73	70	15	68	5¾ min. late
71.7	Surbiton	,,	—	71	25	64	
74.0	Malden	,,	—	73	40	62½	
75.1	Raynes Park ...	,,	—	74	40	64	
76.5	Wimbledon ...	,,	—	76	0	65	
78.2	Earlsfield	,,	—	77	30	68	
79.9	Clapham Jctn. ...	,,	84	79	5	40	Service slack
81.0	Queen's Rd. ...	,,	—	80	30	47½	3½ min. late
82.4	Vauxhall	,,	88	82	30	—	3 min. late
83.8	Waterloo	arr.	92	85	30	—	2 min. late

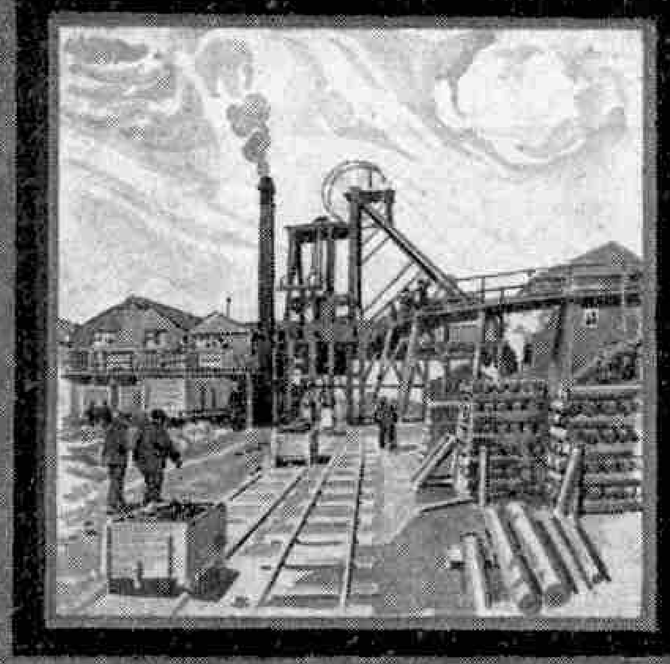
Load: 10 corridor coaches and two dining cars=388 tons empty and approximately 415 tons with passengers and luggage.

First Test Run

The first official run of the "*Lord Nelson*" took place on 12th October last when the down "Atlantic Coast Express," 11 a.m. out of Waterloo, was hauled as far as Salisbury, the engine making the return trip from Salisbury on the "up" "Atlantic Coast Express." The approximate weight of the train in each case was 420 tons.

Leaving Waterloo punctually at 11 a.m., the train consisted of twelve well-filled coaches, and made an excellent run into Salisbury, arriving 35 secs. ahead of schedule, after covering the distance of 83.8 miles in 89.25 secs. The fastest recorded speed was 82 m.p.h. attained at Andover, while the 75.4 miles between Wimbledon and Tunnel Junction were run in exactly 75 minutes.

The return journey provided a greater test of the engine's capabilities, however, for the start was made 8½ minutes after time and the run throughout was accompanied by a very steady drizzle of rain. Despite this, the train arrived at Waterloo only 2 mins. behind time, having covered the run in 85 mins. 30 secs. From Worting Junction to Esher, 36 miles, the average speed was 73.85 m.p.h., the speed falling below 70 m.p.h. only momentarily to 69 m.p.h. when passing the mile post 31 miles out from Waterloo; while from Grately to Earlsfield, 67 miles, the speed (*Continued on page 155*)



THE STORY OF COAL

IN the series of articles under the heading "*The Story of Metals*" we have dealt during the past two or three years with all the more important metals, including iron, copper, lead, tin, aluminium, gold, silver, zinc and nickel. In every case we have seen that, in the extraction of these metals from the native ore, it has been necessary to make use of the most familiar of all minerals, namely, coal. It is obvious that in this direction alone coal is of immense importance.

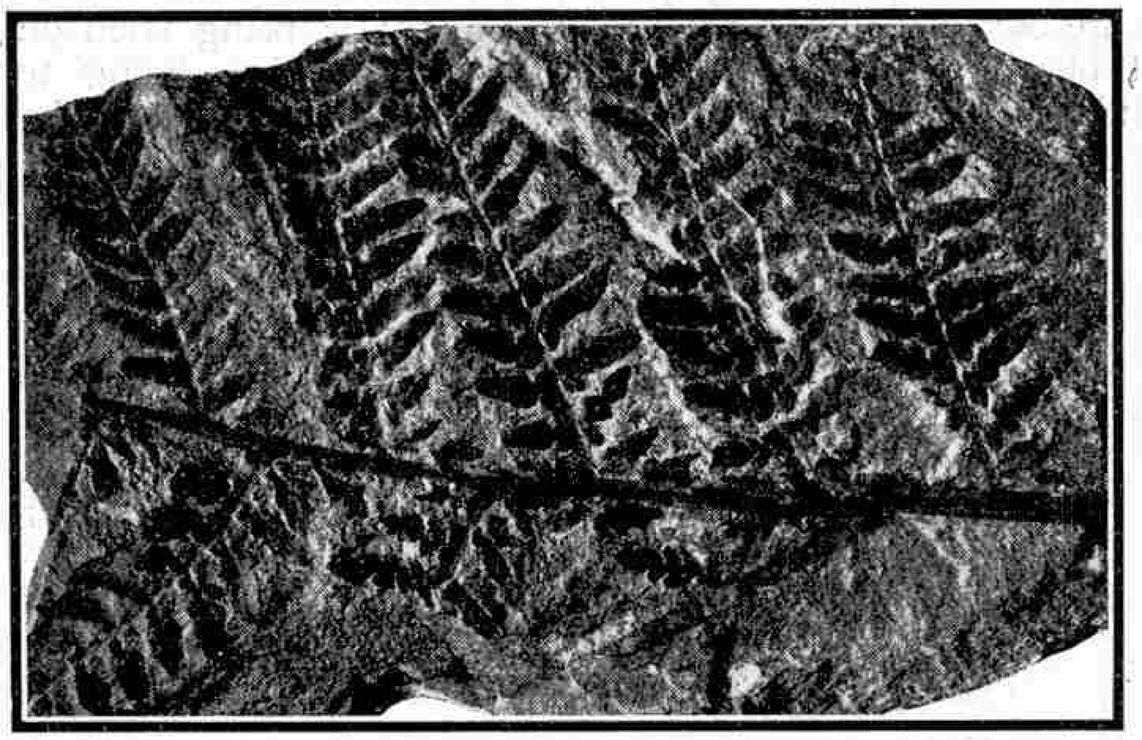
Passing beyond this, a few moments' thought will show us what an enormous part coal plays in our daily life. The extent to which we are dependent upon it for domestic purposes is only revealed fully during a time of shortage such as occurred during the prolonged coal strike of last year. During that period also vast numbers of people must have perceived more clearly than ever before how utterly the industry of the country is dependent upon this mineral. Coal is, in short, the source of power upon which the immense industrial developments of recent years have been built up.

A Unique History

In addition to its enormous practical value, coal possesses a history that is unique in its fascination and romance. The story goes back to a period in the world's history when vegetation had reached a luxurious profusion such as probably it has never attained since and never will again attain.

Very large portions of the world, many of which now have a temperate or even a cold climate, were covered with vast tropical forests of trees and tree-ferns; while swamps that covered immense tracts of land were hidden by a dense undergrowth of ferns, grasses and plants of all kinds. At this period man had not yet appeared, and the only inhabitants of forest and swamp were weird creatures, some of them of enormous size, that have been extinct for countless ages.

The climate at this time must have been warm and moist and in all probability the rainfall was extremely heavy. It is probable also that the atmosphere then contained a larger proportion of carbonic acid gas than is the case to-day, and according to Professor Tyndall this would have the effect of checking the radiation of heat from the earth. Thus the combined conditions of heat and moisture were ideal for luxuriant growth of vegetation.



Neuropteris, or nerve-fern, a typical Coal Measures plant

Photos courtesy] [*Director Geological Survey and Museum*

Lepidodendron, or scaly tree, a plant resembling a club-moss

Primeval Forests

During the passage of innumerable centuries the earth's crust gradually cooled, during which process it contracted, giving rise to subsidences on a vast scale. As a result many of the densely wooded areas, which already were at a low level, became flooded, and the hidden swamps grew into vast lakes that submerged the undergrowth. Sand and mud were washed in and deposited by the invading water to such an extent that the drowned and decaying trees and undergrowth eventually became completely covered.

By the continued deposition of layer after layer of material, the earthy deposit gradually increased in thickness until it reached and emerged from the water, and vegetation then recommenced to grow. This threefold process—growth of vegetation, decay, and renewed growth when a new land surface emerged from the water—was repeated over and over again during the long ages.

Each successive layer of vegetable matter was pushed down under the pressure of the steadily increasing weight of sand and mud deposited upon it. This compression continued for an immense period of years, bringing about remarkable changes in the structure of these layers, and ultimately the material that once consisted of the living substance of trees and plants became converted into coal. Later we shall trace the various stages in this marvellous transformation.

As the ages passed, a gradual modification of the earth's climate took place. Little by little the vast area in which tropical or sub-tropical conditions existed became smaller, giving place both north and south to a more temperate climate. This change in climate was combined by a corresponding change in the nature of the vegetation. Finally there came a time when the ancient tropical vegetation had entirely disappeared and all that remained to testify to its former profusion was the crushed and crumpled layers of dead vegetation hidden beneath the surface of the earth.

Typical Forest in the Carboniferous Age

The Carboniferous Age

The period in the world's history in which were deposited the layers of vegetable matter from which our present-day coalfields are mainly derived is known as the Carboniferous Age. It has been estimated that during this period the vegetable matter was deposited to a total thickness of one yard during every thousand years.

It should be understood clearly that the geological period known as the Carboniferous Age is not the only period from which coal is derived. No doubt the formation of coal began long before this period and continued long after it, and as a matter of fact it is in progress to a certain extent to-day. What we call the Carboniferous Age is, however, the period during which the great coal seams were being formed, and from it is derived most of the coal that is now being mined.

Although, as we have seen, vegetation reached during the Carboniferous Age a profusion such as it has not attained since, we are able to form some dim idea of the conditions then existing from the present-day cypress swamps on the flood-plains of the Mississippi, the forests of the Amazon and the mangrove swamps of various tropical countries.

Sir Frederick Treves, the famous surgeon, in his book, "*The Other Side of the Lantern*," gave an excellent description of a mangrove swamp in Singapore.

"The mangrove swamp," he wrote, "is the slum of the tropical jungle, the squalid quarter of the imperial forest. It is dismal and dark, cramped, stifling, and ruinous. So thick are the boughs overhead that no light of the sun can ever pierce the dark, mildewed tangle of the place. So dense are the trunks below that none but a small, mean beast or a creeping thing could find a way through the network. Dead creepers hang into the gloom of this forest morgue; dead boughs block every gap and path as with the debris of some grim disaster; about the ground are dead trunks, with shrunken and contorted arms, and bare roots, in worm-like bundles, that seem to be writhing out of the ooze."

A Stack of Peat on the Yorkshire Moors

Nature of Coal

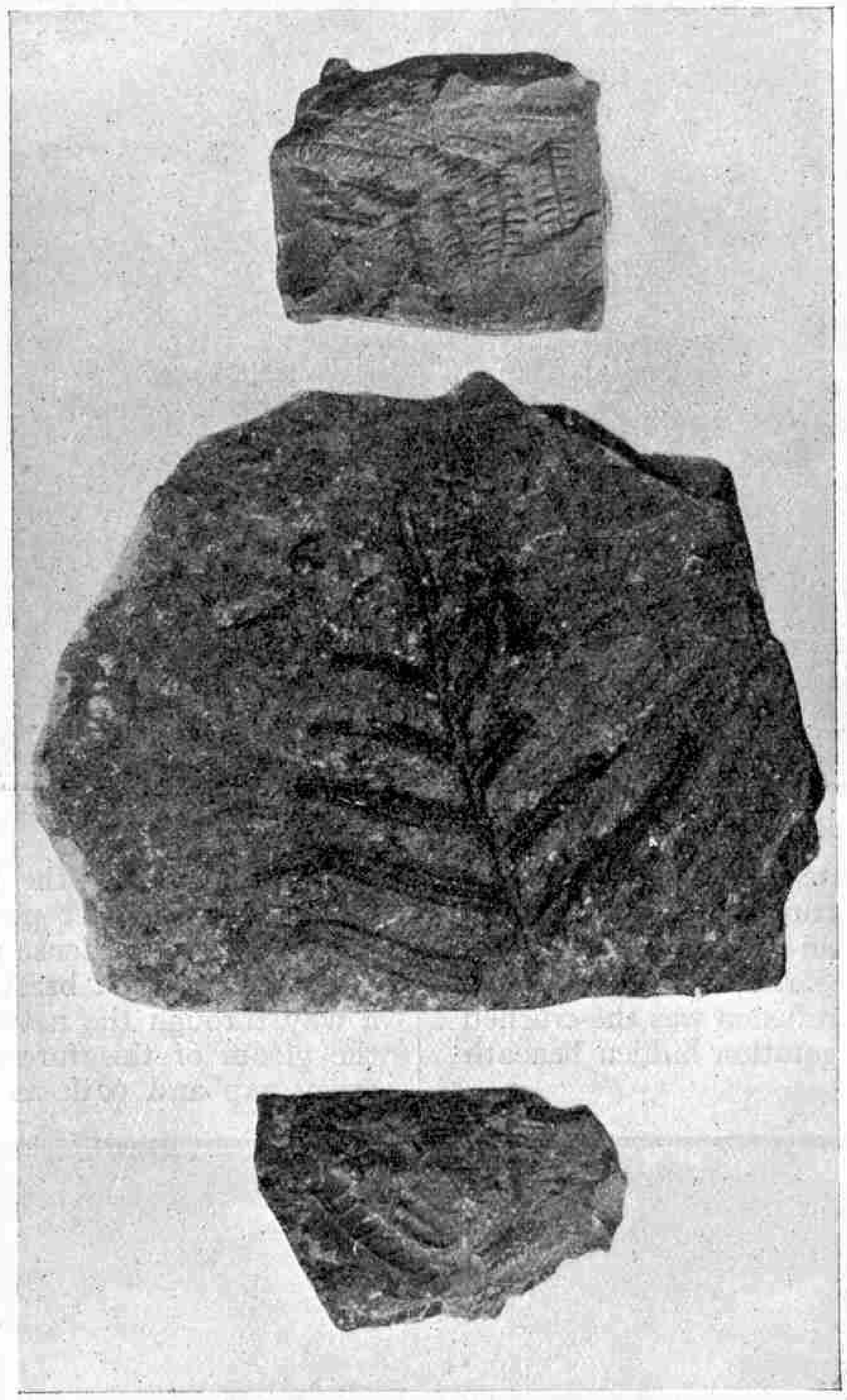
The reader may ask how it is that we are able to state with such certainty that coal is the mineralised remains of decayed vegetation. Fortunately the evidence is quite plain. Extremely thin sections of coal examined under a powerful microscope often reveal traces of woody fibre and bark, and sometimes also spores of various fern-like plants.

Coal is usually found in layers, known as seams, more or less parallel to one another. A seam usually rests upon a bed of hard clay, known as the under-clay, the nature of which is similar to that of the soil of a

river delta. This under-clay is really the old soil upon which the trees grew, and frequently it contains fossil remains of these trees and of the rootlets that penetrated down into it. All the evidence of this nature taken together indicates undoubtedly the vegetable origin of coal.

The fossil remains found in the great coal seams are not of the same nature as the trees of our own forests, but are closely related to the tree-ferns of New Zealand and various tropical regions or are similar to our club mosses and horse-tails. The two last-mentioned plants are to-day quite small, but in the Carboniferous Age they grew into giant trees sometimes attaining a height of 50 ft. or 60 ft.

The coal seams just described were almost certainly formed from the growth and decay of forests on the spot where the seams are now found. There are, however, coal seams that have no underlying bed of clay, and they have been something of a puzzle to geologists. It is now believed that these seams were formed from the vegetation of swamps and marshes lying close to the banks of rivers. This vegetation was carried away by the current and deposited at the mouth of the river or perhaps in ponds and lakes.



Fossil remains of typical ferns that lived in the Carboniferous Age. The fern in the upper photograph was then as common as bracken is to-day. This illustration is from "Coal and its Story," by Edward A. Martin, which book will be reviewed in the "M.M." shortly

The Formation of Peat

We come now to the various stages in the transformation from vegetable matter to coal. The first substance formed is probably peat, which consists of stems, leaves and roots of various plants which have suffered change only to the extent of losing some of their gaseous elements, oxygen and hydrogen, with the result that the remaining carbon is proportionately increased in amount. The formation of peat may be observed to-day in various parts of the world such as Ireland, Norway, Germany, Russia and Canada.

When cut and dried, peat burns with a comparatively small amount of heat accompanied by a great deal of smoke. Many people made their first acquaintance with peat as a fuel during the coal strike last year and were able to realise its great inferiority to coal as a domestic fuel. As a matter of fact peat is only economical as a fuel in places where coal has to be brought from long distances and is therefore very dear. In addition to its use as a fuel, peat is of importance also for the manufacture of fertilisers, and for stable litter and as packing material.

The main difficulty in utilising peat commercially is that of drying it. The peat bogs exist only in regions having an abundant rainfall and naturally local conditions are not such as to allow the thorough drying of the cut peat in the open air. On the other hand artificial drying has not so far proved a profitable undertaking. It is quite possible that as coal becomes scarcer the demand for peat will increase, and then no doubt the drying and other difficulties will be overcome.

It is interesting to note that peat has been successfully converted into coal by artificial methods. The peat along with water was heated at a pressure of 100 atmospheres to a temperature of 340°C. At the expiration of eight hours it was found that the peat had been transformed into a solid mass possessing chemical and physical properties identical with those of natural coal. Another experiment was made at the lower temperature of 310°C., and on this occasion 60 hours proved necessary to bring about the same conversion. From these interesting experiments it has been calculated that, at the low temperature of the earth's crust, the complete transformation of peat into coal would require some million years!

Lignite, or Fossil Wood

The next stage in the making of coal is the production of what is known as "*lignite*," or brown coal. The name comes from the Latin word *lignum*, meaning wood, and the substance is quite clearly made up of fossil wood. As compared with peat, lignite has lost a good deal more of its gaseous elements and consequently the proportion of carbon is considerably larger. Lignite is of little use as a domestic fuel but has been used in various industrial operations. When burned it produces a large amount of smoke together with unpleasant sulphurous fumes. It now finds its greatest use in Germany as the result of special attention paid to it during the difficult conditions produced by the Great War.

True Coal—The Last Stage

Lignite, as we have seen, retains a good deal of the nature of wood. During the next stage the original woody structure is destroyed, resulting in the production of true coal.

True coal, other than anthracite, is known as bituminous coal. The term is misleading, for such coal does not contain any bitumen at all, and derives its name solely from the fact that it burns with a flame similar to that of bitumen. Bituminous coal comprises a very large proportion of all the coal mined and it is used for domestic purposes and in industrial operations of almost all kinds.

Anthracite is the hardest of all coal, its characteristics being lack of smoke, small amount of flame and capability of attaining very great heat.

(*Continued on page* 183)

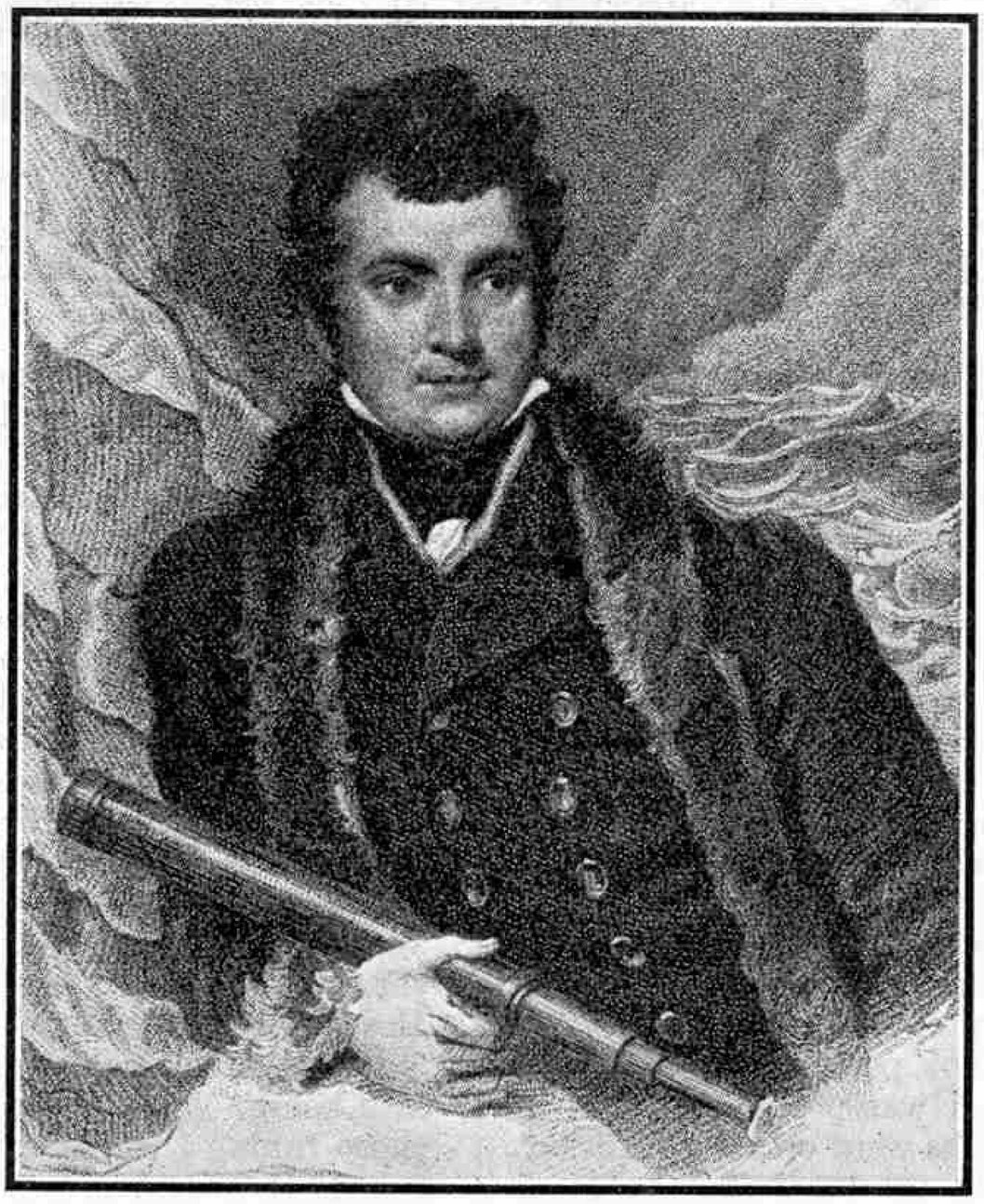
EXPLORING THE ARCTIC

Famous Explorers and their Attempts to Reach the Pole.

VI. SIR JOHN BARROW AND W. E. PARRY

NEARLY all voyages of Arctic discovery were interrupted by the French Revolution and the Napoleonic wars, but after 1815 important work was done in the Arctic, particularly at the instance of Sir John Barrow. This remarkable man was born on 17th June, 1764, in a thatched cottage at Dragley Beck, near Ulverston in Lancashire. Although his parents were very poor and his opportunities therefore limited, he educated himself so successfully that ultimately he became Secretary to the Admiralty, in which capacity he served for 40 years.

Barrow's first situation was as a clerk in an iron foundry at Liverpool, but later he gave up this position and became attached to an academy at Greenwich where he taught mathematics, in which subject he was particularly interested. Later, Sir George Staunton used his influence to obtain for him a place in the first British Embassy to China, and his foot being thus placed on the first rung of the ladder he proceeded to climb. It is only fair to Barrow to state, however, that this original introduction was the only occasion in which he was assisted by influence, and every step in his subsequent career may be fairly said to have been achieved solely by his own efforts. Remarkable though it seems, within the space of a few months Barrow overcome the tremendous difficulties of the Chinese language and soon began to converse in it, subsequently acquiring a complete knowledge of its theory. He made several valuable contributions to literature and science in connection with China and later wrote a book on his travels.



Captain W. E. Parry, R.N.

In 1794 the Embassy returned and Barrow's connection with it having ended, his services were secured on an important delicate mission in connection with the newly acquired colony of the Cape of Good Hope, where he was entrusted with the opening of communication with the Kaffirs.

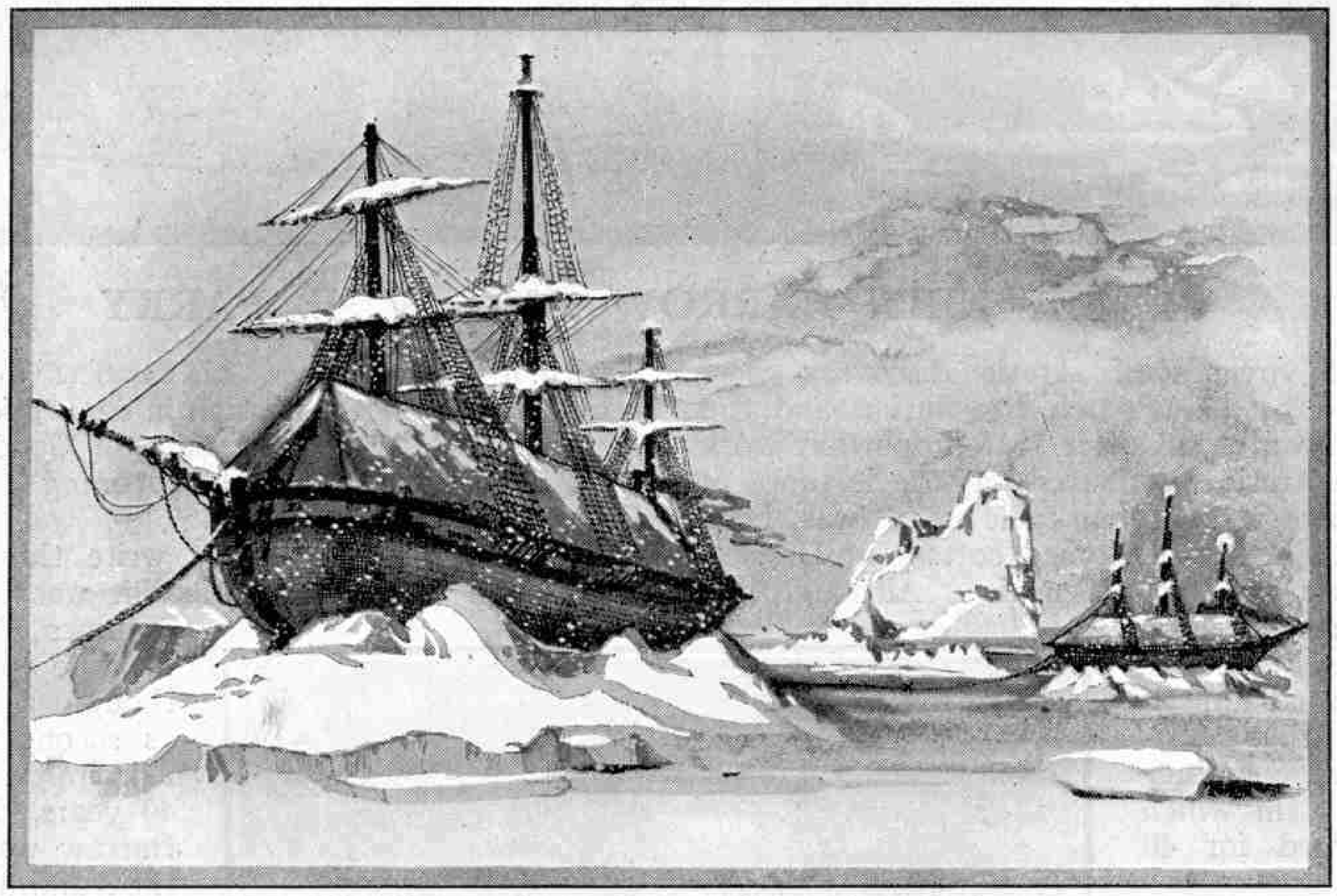
His next work was to write the history of South Africa in two volumes, and it was a perusal of these volumes that decided Lord Melville to appoint him, although a perfect stranger, as second Secretary of the Admiralty. In the following 40 years, during which time Barrow was connected with the Admiralty—a period that included the whole time when we were at war with France—he enjoyed the confidence of eleven chief Lords who successively presided at the Admiralty, and more particularly so of King William IV. He died on the 23rd November, 1848, in his 85th year, honoured and respected by his friends and by the public at large.

Barrow's interest in the Arctic dated from the time when, at the age of 17, he made a voyage in a Greenland whaler. As a result of strong representations that he made in 1818, four whalers were sent out to explore the polar seas. Two were to attack the question of the northwest passage from the Atlantic to the Pacific, and the others were to endeavour to reach the Pole. The main object of each vessel, however, was not so much the accomplishment of voyages by either route, as the acquisition of useful knowledge.

The "*Dorothea*" (Captain Buchan) and "*Trent*" (Lieut. J. Franklin) were to attempt the voyage to the Pole. They sailed by way of Spitzbergen, where they were driven into the pack-ice and severely crushed. The "*Isabella*" (Captain John Ross) and the

"*Alexander*" (Lieut. Parry) were to attempt the northwest passage. They sailed into Baffin Bay, explored the northern shore and passed on into Lancaster Sound. Ross declared that this ended in a mountain range, whereas it was later found to be a through strait, leading by way of Barrow Strait to Melville Sound, Ross having mistaken clouds for what he aptly named the "Croker Mountains." Believing his way westward to be barred by these mountains Ross returned to England, thinking that further efforts were hopeless.

Parry was full of confidence, however, and expressed his opinion "that attempts at Polar discovery had been hitherto relinquished just at a time when there was the greatest chance of succeeding." As a result of this Parry, who had seen no mountains and who told Sir John Barrow so, was despatched on another expedition in 1819.



H.M.S. "*Hecla*" and "*Griper*" in Winter Harbour

William Edward Parry, who became one of the most notable of nineteenth-century explorers, was born on 19th December, 1790, the fourth son of a celebrated Bath physician. Educated at the Bath Grammar School, he was intended for the medical profession, but preferring the sea, he joined (in 1803) the "*Ville de Paris*," the flagship of the Channel Fleet, as a volunteer. In 1806 he was midshipman in the "*Tribune*," and two years later transferred to the "*Vanguard*" in the Baltic Fleet. In 1810 he obtained a lieutenant's commission and joined the "*Alexander*," a frigate employed in the protection of the Spitzbergen whale fisheries. It was in this way that he came into contact with the Arctic regions, with which his name was destined to be so closely associated.

Parry, who was interested in astronomy and navigation, published a small volume on "*Nautical Astronomy*" and also employed himself in preparing accurate charts of the northern regions. He took part in the American war of 1813 and four years later was posted to a North American Station, from whence he went on an expedition up the Connecticut River. As we have already seen in 1818 he was in charge of the "*Alexander*" in the expedition organised by Sir John Barrow.

Parry's second voyage to the Arctic, the expedition of 1819, consisted of two vessels the "*Hecla*" and "*Griper*," which sailed from Yarmouth on the 12th May, 1819. Thereafter Parry did not drop anchor for nearly four months, during which time he sailed through Baffin Bay and Lancaster Sound—which he found was not blocked by mountains as Ross had stated—until he reached (on the 5th September) Melville Island. Parry's previous Arctic experience served him in good stead. He had both vessels rigged as barques, this being the most convenient rig among the ice, and worked his men in three watches.

After passing through Lancaster Sound and Barrow Strait, Parry discovered new lands, which he named North Somerset, North Devon, Beechey Island and Cornwallis Island, and penetrated regions then unknown except to the Norsemen. The discovery of Griffith and Bathurst Islands followed, and at Byam Martin Island on the 27th August, Captain Sabine, the astronomer of the expedition found that they had passed north of the magnetic North Pole.

Coasting along the south side of Melville Island they discovered Dealy Island on the 4th September, and at a quarter-past nine at night, just after passing a large cape, the "*Hecla*" crossed the 110th meridian west, thus becoming entitled to the Government grant of £5,000. Bounty Cape was so called in the honour of this event, and the grant, when subsequently paid, was shared by Parry between the two ships.

Still sailing westward, the vessels encountered the impenetrable pack-ice. After passing Cape Providence and sighting Cape Hay, conditions became increasingly difficult, so that it was decided to go into winter quarters and they returned to Winter Harbour. Here the "*Hecla*" sent down all her upper masts except the main top mast, whilst the "*Griper*" housed her fore and main top masts. The spars were used to support a roof that completely covered the upper decks and made them snug for the winter.

The officers, led by Parry himself, kept the men amused and on the move. Some books of plays and theatrical costumes had been bought in London and the Royal Arctic Theatre—the pioneer of many similar amateur theatrical ventures in the Polar Seas—came into being. Plays were performed once a fortnight and those taking the part of "ladies" had to shave off the beards they had grown as a defence against the cold! An evening school was started at the wish of the men and the first ships' newspapers were published in the form of the "*North Georgia Gazette*" and the "*Winter Chronicle.*" On Christmas Day there was a dinner of roast beef, which although it had been on board from the previous May, was nevertheless in an excellent condition.

All through the winter the food was good and abundant, and with such activities as those mentioned, the time passed quickly enough. In the spring, game was found in fair quantity and some 4,000 lbs. of musk-ox, hares,

deer, geese and ducks were brought on board. By the following May the vessels were afloat again, although still ice-bound. In June walking journeys were organised, and on the 1st August the vessels moved out of the bay to the west.

Six days later land was sighted, being the most westerly point yet discovered in the Arctic Ocean, to the north of the American continent. Parry named this new land Banks Land, after the late President of the Royal Society. Here the passage along Banks Strait was effectually barred by ice floes 50 ft. thick, which were heaped up by the tides and formed a landscape of countless hills and valleys that stretched as far as the eye could see.

This famous picture, "The North West Passage," was painted by Sir John Millais and hangs in the Tate Gallery. It shows an old sea captain and his daughter, who is reading from a log book of her father's voyages in the Arctic Regions. Before the captain is spread a map of the Arctic and his ship's flag is seen in the background

Having reached longitude 113° 46′ 43″ west and established another record, Parry returned to England through Lancaster Sound, after a most successful voyage. Even as early as the following year the whaling vessels followed his route through Lancaster Sound, and his discoveries opened up a very profitable fishing ground.

In 1821 Parry made his third voyage to the Arctic, taking the "*Hecla*" with George F. Lyon in command, Parry himself being in the "*Fury*." On this occasion both vessels were exactly alike, and their gear and fittings were interchangeable. They sailed from the Nore on the 8th May and proceeding directly up Frozen Strait, reached Repulse Bay on the 22nd August after experiencing much trouble from the ice, which threatened to stop them on more than one occasion.

On this voyage red snow was seen. This red snow in its appearance "was not unlike what is called raspberry ice in a far better climate where cold is made subservient to luxury." As was explained in the "*M.M.*" some time ago (December 1925) this colouring of the snow is due to a microscopic algæ, the scientific name of which is *Protococcus nivalis*.

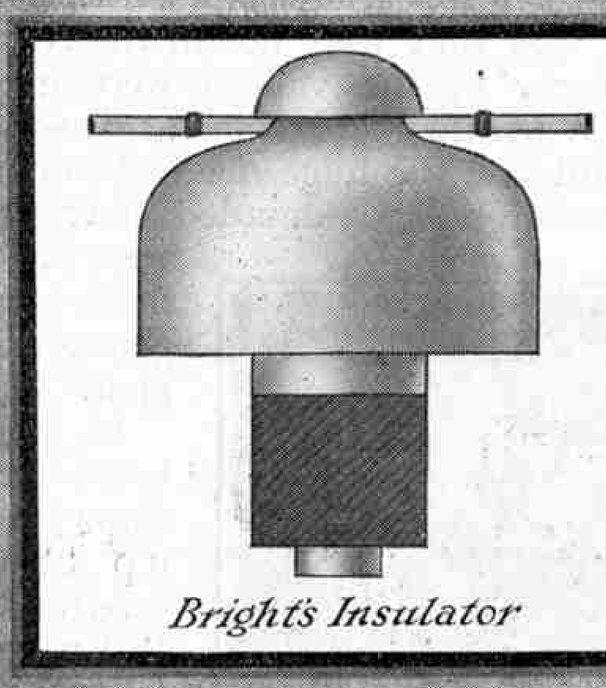
It is interesting to remark that the day on which the snow was found was so hot that the explorers were glad to pull off their coats and waistcoats. It was so fine, indeed, that a number of butterflies and spiders came out of hiding and their appearance almost deceived the men into believing that they were not in the Arctic regions—more particularly as the valleys were green with grass and moss. When they looked in the direction of the Frozen Strait and saw the huge mass of moving ice, however, they were forcibly reminded that they were in a most dangerous region.

In October the ships took up their quarters at Winter Island on the coast of Melville Peninsula, where they made friends with the Eskimos. The natives told Parry of a passage further north and this he was able to use in the following July, and by it he discovered Fury and Hecla Strait. Here he found his progress blocked, however, and had to return, reaching the island of Igloolik 69° 20′ N. where the ships passed their second winter. Igloolik was an important Eskimo settlement where there were four different places of residence, the natives living in them by turns, moving from one to the other in rotation with the seasons. After spending his second winter here, Parry returned to England and dropped anchor in the Thames on Trafalgar Day 1823.

On the 19th May of the following year Parry was off again on his fourth voyage to the Arctic. This time his endeavour was to seek a passage to the west, down Prince Regent Inlet, and he was in the "*Hecla*" with Hoppner in the "*Fury*." It was a bad season, however, and the ships did not leave Baffin Bay until late and soon encountered ice in Lancaster Sound. They could not even get further than Port Bowen in Lat. 73° 12′, and here they had to spend the winter.

In the following July, in an endeavour to force a way through the ice, the "*Fury*" was wrecked. After her stores had been left carefully stacked on Fury Beach, for the use of future explorers who might be glad of them, the "*Hecla*" came home alone, with the "*Fury's*" crew aboard.

Next month we shall describe Parry's fourth voyage and his gallant dash to try to reach the Pole with specially-designed boats on runners.



Bright's Insulator

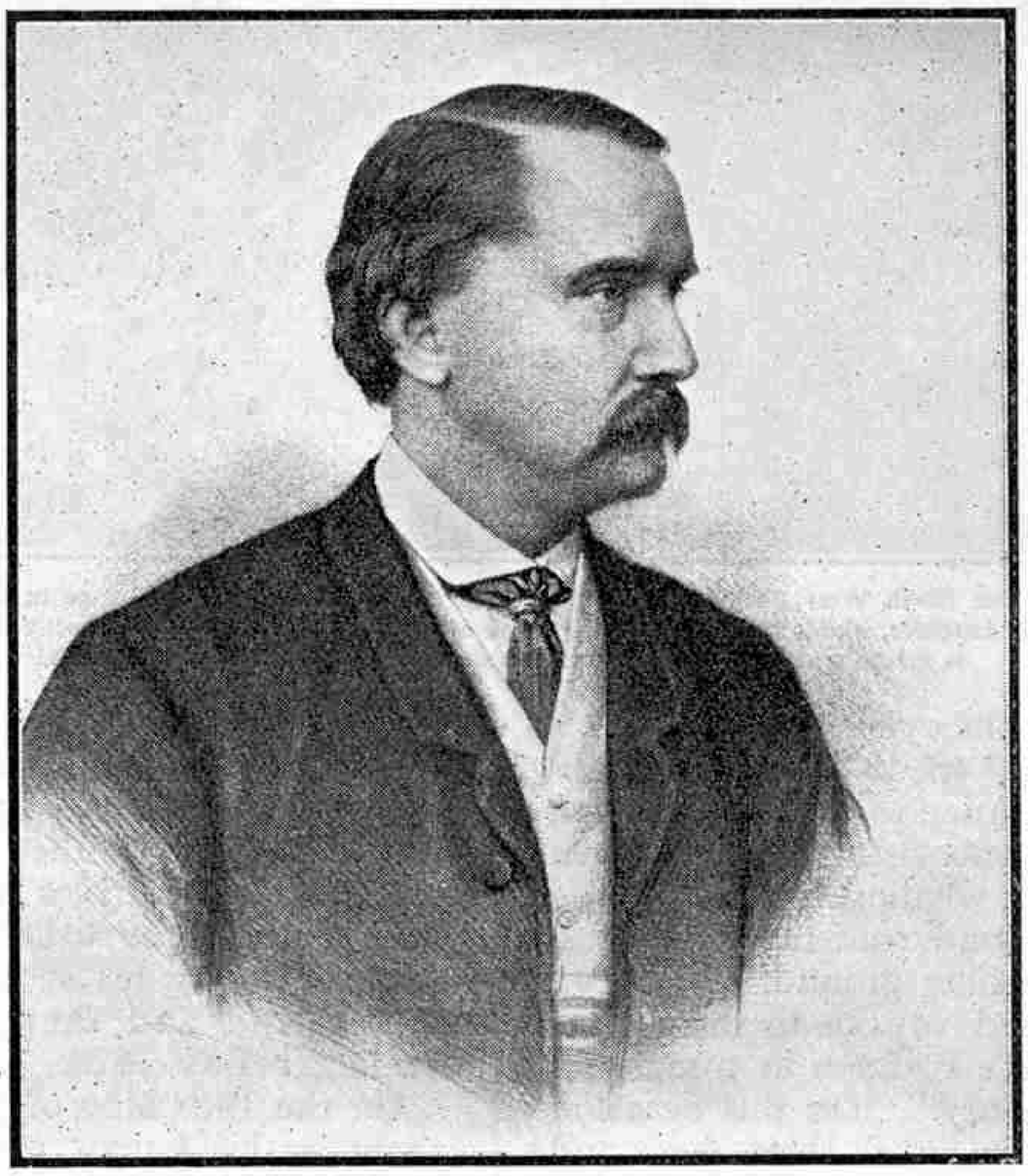
Lives of Famous Engineers

XXXVI. SIR CHARLES TILSTON BRIGHT
TELEGRAPH ENGINEER

IN our previous articles we followed the progress of the Atlantic cable up to the final establishment of a permanent line. In the meantime other activities of Sir Charles Bright were passed over, and to these we must now turn. Actually he became closely connected with many other cable-laying enterprises immediately after the completion of the 1858 line.

It will be remembered from previous articles that at this date, although only twenty-six years of age, he had produced many inventions in connection with electric telegraphs and had successfully established many telegraph lines, including submarine lines to Ireland and across the Atlantic. He was, therefore, undoubtedly the foremost authority on telegraphs generally and on submarine cable work in particular, and as a result he was concerned, either directly or in a consultative capacity, with practically all successful cable-laying enterprises for many years. During that time he was personally in charge of actual work in regions so far apart as the Mediterranean, the Persian Gulf, India, and the West Indies, and in 1897 the President of the Institution of Electrical Engineers, Sir Henry Mance, was able to say :—

"If we, as engineers, desire to do honour to any one individual who pre-eminently distinguished himself in the development of oceanic telegraphy, we have simply to refer to the list of our Past-Presidents, and select the name of Charles Tilston Bright."



Sir Charles Tilston Bright

Empire Telegraphic Communication

Shortly after the laying of the 1858 Atlantic cable, the Government began to consider proposals to establish direct telegraphic communication between Great Britain and her dependencies. The first point considered and decided upon was Gibraltar. In this connection Bright was associated with Robert Stephenson, the famous railway engineer, in experimental work on the composition of the outer coverings of cables, and finally, at the request of the Government, sent in a detailed report, estimate, and specification. He recommended a cable containing nearly 400 lb. of copper to the mile—practically the same size as he had ineffectually suggested for the first Atlantic cable and which was afterwards used in 1866—while his method of protection by a combination of hemp and iron was adopted also. The Government had the cable made according to this specification in 1859, but decided to use it for connecting Rangoon with Singapore, in order to facilitate rapid communication with the East, as war with China was in progress. Its final destination, however, was again changed, as the Chinese war ended before it could be used for this purpose, and it finally came into use in the Mediterranean as a link with Egypt.

In the meantime, in 1860, Sir Charles had succeeded in overcoming serious difficulties in the way of cable-laying in the deep waters of the Mediterranean Sea, and had connected Spain and the Balearic Islands by several cables on behalf of the Spanish Government. About the same time also he was concerned with his company, The Magnetic Telegraph Company, in constructing long land lines from London to the coast to join up with various submarine cables to the Continent. One of these lines went to Cromer, from which town the submarine cables to Hanover and Denmark started. It was an overhead line, and although the poles were handsomely made and painted green, many objections were raised against their unsightliness by residents in the districts through which the line passed, and amusing incidents occurred in consequence. The song of the wires appears to have acted as an irritant on most people, many of whom at the time believed that the

humming was produced by the passing of messages!

Ganger and the "Old Gent"

On one occasion when Sir Charles was inspecting part of the new work near Norwich he noticed that the "ganger," a big powerful man, had one side of his head much bruised. On being questioned he explained that on putting up a pole opposite a villa, "the old gent came out of his front garden with a spade and gave me a clop on the head with it, so I just twisted his collar until his tongue came out, and then we were quite friendly!"

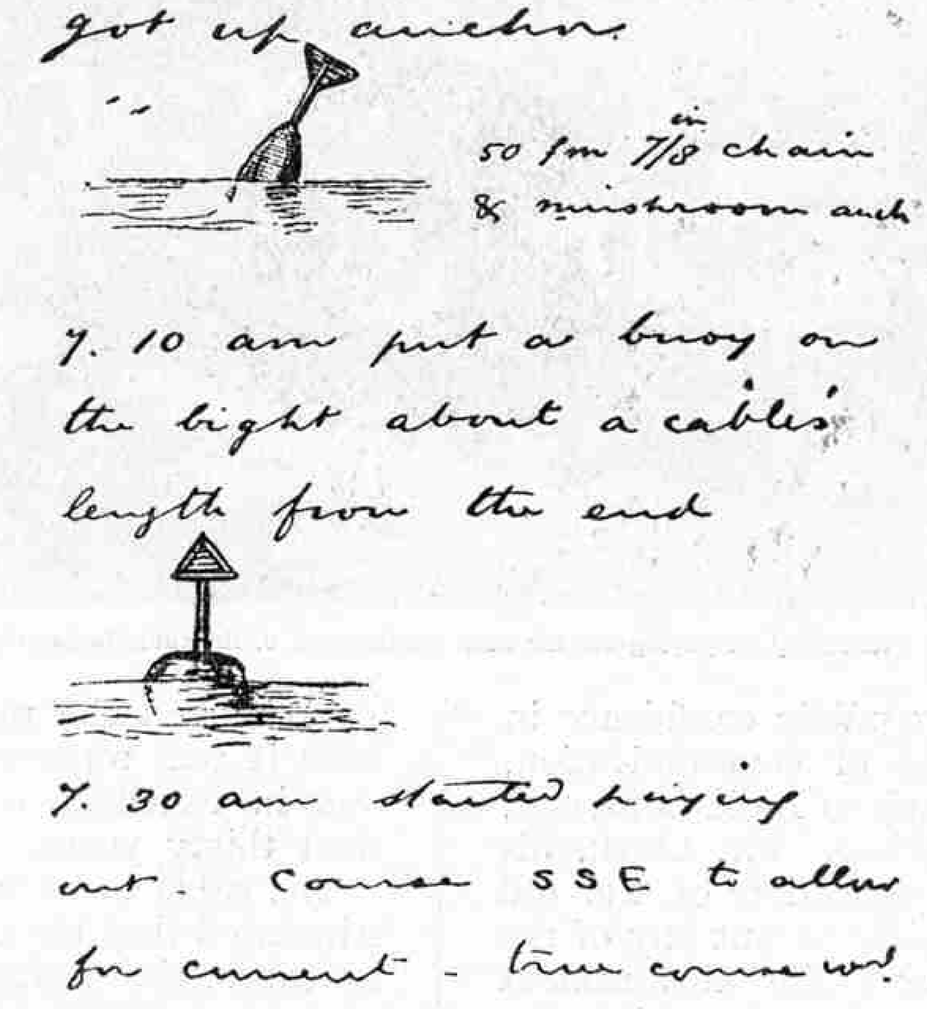
It was during a journey in connection with this work that one of his colleagues surmised correctly that Bright had passed through Norwich ahead of him, on discovering that a previous traveller had consumed the entire store of mixed pickles in the principal inn!

Partnership with Latimer Clark

Bright's work in connection with the various submarine telegraphs then contemplated seemed to offer more scope than his earlier line of work as the active Engineer-in-Chief to the British and Irish Magnetic Telegraph Company, and in consequence he resigned the latter post in 1861 and became Consulting Engineer instead, a position that he retained until the telegraphs became a State Institution in 1870. His example was followed by Latimer Clark, engineer of the Electric and International Telegraph Company, and these two, the engineers of the two largest telegraph companies in existence, joined forces in establishing the firm of Bright and Clark, consulting telegraph engineers.

This was a combination of scientists as well as engineers. Both the partners were interested in the question of electric standards, units, and measurements, and were leading members of a committee of the British Association that worked for eight years on this subject, finally evolving the present system of electrical units. They were, indeed, the actual originators of the names ohm, ampere, farad, volt, and coulomb applied in this manner.

Referring to this important work some years later, Lord Kelvin said: "I may mention that a paper was communicated to the British Association in 1861 by Sir Charles Bright and Mr. Latimer Clark, in which the names that we now have were suggested; moreover, a complete continuous system of measurement was proposed which fulfilled most of the conditions of the absolute system in an exceedingly useful manner. To Sir Charles Bright and Mr. Latimer Clark, therefore, is due the whole system of nomenclature in electrical units and standards."



A Reproduction from Bright's Diary

An Important Patent

The most important works carried out by the firm of Bright and Clark were in connection with submarine cables. They continually introduced fresh improvements in the construction and manufacture of cables, and in 1862 Sir Charles took out a very important patent. As this patent described a method of manufacturing submarine cables that was almost universally adopted, we quote the following description from the biography by the present Sir Charles Bright* referred to in previous articles of this series:—

"By this invention two layers of hemp or other yarn are wound round the sheathing wires in opposite directions, each layer being saturated with a preservative adhesive compound of bitumen and tar. It was thought that the layers of yarn and bituminous composition so applied would effectually check the oxidation of the iron wires—by acting as a more or less waterproof, and even air-tight, casing; and so it proved. It was soon found that such an outer cover also behaved as an excellent binder for the sheathing wires, and in holding them in place got over the trouble caused by broken wires getting adrift."

Bright, after many experiments, had arrived at an improved composition, and he devised a very ingenious method for its application. Again we quote from the same source:—

"Here, instead of the cable passing through the hot compound, the latter, whilst yet plastic, is poured over it in streams by an elevator from a tank. Furthermore, inasmuch as this process is performed simultaneously with the laying on of the hemp, or jute, yarns—by having the shaft of the compound apparatus geared to the rest of the cable machine—the delay of the double manufacture is saved."

A novel feature of the process was that the cable, after being coated with the compound, was drawn between rollers under a stream of cold water, forming a hard and even surface that greatly facilitated laying or recovery operations.

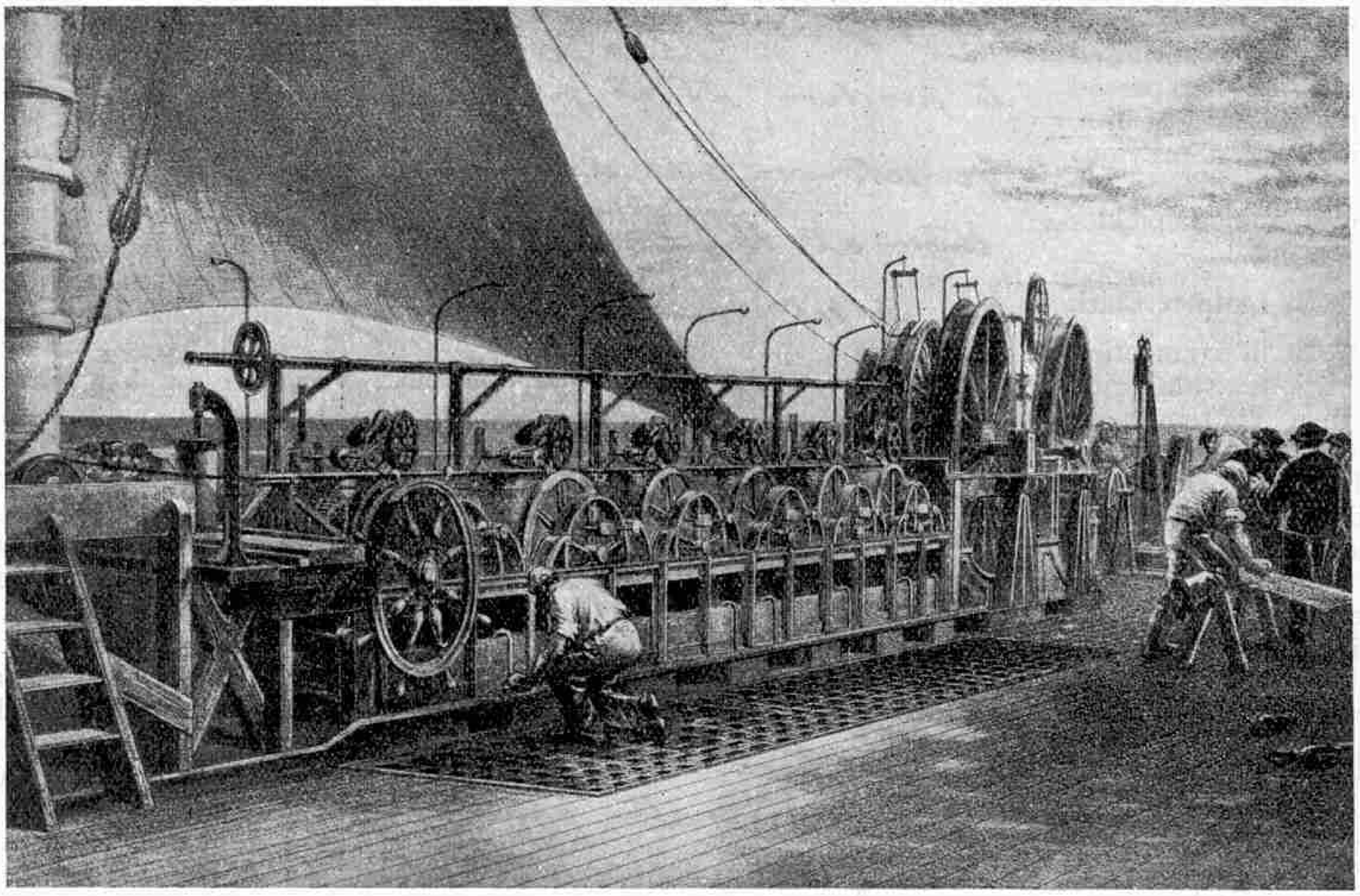
Cable to India

The prestige acquired by the firm of Bright and Clark through these methods, as well as by the past experience of the two men themselves, led as already mentioned to their association with cable-laying in all parts of the world, and in 1862 Sir Charles Bright was called upon by the Government to undertake the construction and laying of a cable to India. This was a work of capital

*"*Life of Sir Charles Tilston Bright*," by Sir Charles Bright, F.R.S.E. Archibald Constable & Co., London.

importance, for rapid communication between England and India was now a vital necessity from a political as well as a commercial standpoint.

The dangerous Mutiny had occurred only a few years previously, and the Government had been so impressed with the necessity for a cable that it had given a guarantee to a company, the Red Sea and Indian Telegraph Company, formed in 1858 to lay a cable from Suez, down the Red Sea to Aden, and thence to Karachi, the most westerly of Indian ports. Bright was not associated in any way with this enterprise. The route was insufficiently surveyed, the cable was too light for its purpose and, as it was unduly stretched in crossing submarine hills and valleys, it never worked in a continuous length as intended, and the separate sections broke down after transmitting messages for a few days.



Machinery for paying-out the cable on the deck of the cable-laying ship

The task of repairing the errors of this company, and of restoring public confidence in the submarine cable as a means of communication, fell to a new company, the Telegraph to India Company, with Sir Charles as technical adviser. Mr. Clark, his partner, after investigating the condition of the old cable, reported that it was impossible to put any of the sections into working order, and the Government decided on an entirely new route, from Karachi to the head of the Persian Gulf. The continuation to England was by means of a land line that was being made by the Turkish government, between Constantinople and Fao on the Shat-el-Arab, at the head of the Gulf, the British Government securing an agreement for the use of special wires.

A Worm Outwitted

A careful survey of the route for the submarine portion was made by officers of the Indian Navy, and it was decided to lay the cable in sections, the first to run from Karachi to Gwadur, a coast town about half way to the Gulf, the second from thence to Mussendom on the Arabian coast at the entrance to the Gulf and the third to Bushire near the head. A short section was to make connection with Fao, while from Bushire itself an alternative overland route to the borders of Turkey was to be provided by the Persian Government.

The task of Sir Charles was then begun. Difficulties peculiar to the climate had to be overcome, and one problem that arose was how to baulk the appetite of the teredo for yarn and gutta-percha. The teredo is a little worm that bores its way through wood and similar materials and is very destructive to the timber of ships and jetties. For submarine cables in warm climates it seems to have a special affection. It finds its way into the insulation in the first instance through the interstices that almost inevitably develop on the surface of the cable owing to the strain to which it is subjected during the paying-out process, and then bores right through to the copper core, causing great loss in insulating power. At that time, in fact, it was the deterrent of telegraphs in warm climates. The remedy employed by Bright was the addition of a proportion of powdered silica, made by grinding calcined flint, to the covering compound, and this so effectually checked the ravages of the boring worm that in 1889 it was reported that the gutta-percha insulation was in excellent order after submersion for no less than thirty years.

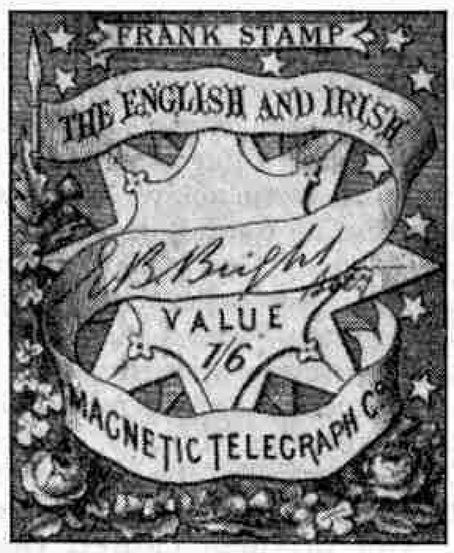
The cable to be used was given special care. It was stipulated that the copper should be of such purity that its conductivity should be at least 76 per cent. of that of the purest copper known, and actually the conductivity of the line when made was nearly 90 per cent. of the maximum. Its electrical efficiency was increased also by adopting Latimer Clark's plan of construction, in which the copper core was built of four segments enclosed in an outer cylinder, also of copper. The area of the surface of a conductor made in this fashion is less than that of one made in the ordinary way with stranded wire of the same weight, and thus retarding effects of induction are lessened.

The laying of the cable proved to be in many ways an adventurous piece of work. Sir Charles proceeded to Bombay, and on the arrival of sufficient cable for one portion proceeded with it to Gwadur and commenced the work of laying the section to Mussendom. The cable-laying ship was towed by steamer, a method leading to considerable difficulty. If, for instance, anything went wrong with the cable, it was impossible to stop the ship's way or alter the course without going through the laborious and often uncertain process of

signalling by lamps or flags. During this part of the voyage, however, the speed of signalling was considerably increased by adapting the Morse alphabet to the methods used, and the expedition arrived at Mussendom without mishap. The line proved to be in splendid order and messages were transmitted at the rate of twenty-five words per minute—a speed never previously attained with submarine cables of such length.

Trouble with Arabs

More than a month was spent at Mussendom waiting for the remaining portions of the cable. A good deal of trouble was experienced with the Arabs, who were wild and savage in the extreme—quite prepared to accept presents of food or money on an unlimited scale, but unwilling to render any assistance in return. Until recently these people had been pirates, and following out their old traditions they were fierce and truculent, resenting the establishment of the telegraph station in their rocky strongholds. By various methods their good will was gained.



One of the telegraph stamps issued in 1853 by the English and Irish Magnetic Telegraph Co. These stamps were lithographed in Liverpool, some in sheets of 50 and others in sheets of 100

Somewhat surprisingly, Sir Charles received an answer to a Masonic sign from several of the hostile ruffianly crew that met him on landing, and when the attitude of the tribesmen again became hostile, the gun boat "*Clyde*" accompanying the expedition gave an exhibition of the power of her guns on the face of a cliff, with excellent results. In the end, a few of the Arabs were well paid to watch the rest—on the principle of "set a thief to catch a thief"—while the chiefs were given presents at a grand reception where some of them managed to put in two appearances! However, on account of the treacherous nature of the Arabs, the permanent station was established on Elphinstone Island, about a mile from the shore.

When the rest of the cable arrived, the expedition left for Bushire and Fao in somewhat rough weather. No particular difficulties were encountered until Fao at the head of the Gulf was reached, when the struggle with mud proved to be the most arduous feature of the whole expedition. When the ship had gone in as far as possible, there were still nearly eight miles of mud-banks to be covered on the way to the beach. It then became necessary to transfer the cable, weighing about twenty tons, to small boats. These, in their turn, grounded while still several miles from shore.

Landing through Miles of Mud

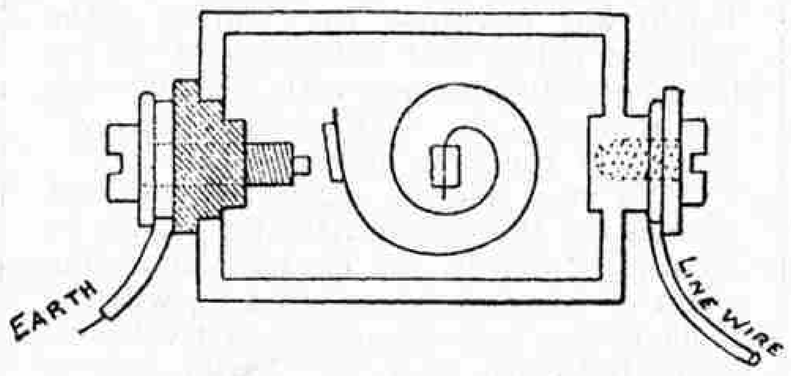
Only one course remained, and without hesitation Sir Charles stepped out of the boat into the mud, which here had the consistency of cream. His example was followed by the officers and men, who waded in slush up to their chests, but still dragged the end of the cable with them. Progress was slow, but after some hours of arduous and dirty work the end of the cable was landed. Another four miles' journey through the slush under a tropical thunderstorm was then necessary to reach the waiting ships. This tried the endurance of the men to the utmost, one of the Lascars being actually overwhelmed by the mud and the rising tide, and sinking before assistance could reach him.

After a fault in the last section of the cable had been found and repaired, the new cable proved to be as good as the first section. Later, the portion of the cable from Gwadur to Karachi was laid, and in 1865 the Telegraph to India Company settled down to a prosperous career. It was generally agreed that the Persian Gulf cable was the first instance of any great length of cable being completely and lastingly satisfactory, and for a paper on its construction Sir Charles Bright received the Telford Medal from the Institution of Civil Engineers.

This pioneer line soon proved inadequate for the volume of traffic that it had to carry, mainly because of delays due to the inefficiency of the Turkish section. It was supplemented, therefore, by the construction of a series of cables giving an alternative route to India, and extensions beyond to the Far East and Australia. Finally, in 1869, the whole of these were merged into one company, the famous Eastern Telegraph Company. Thus was realised one of the great ideas of Sir Charles, which he had set out in "*The Times*," in the House of Commons, and elsewhere; and it was only in the nature of things that he should have been the Consulting Engineer over the construction of practically all these cables.

Elected to Parliament

After the completion of his work in the Persian Gulf, Sir Charles was approached by the electors of several constituencies with a view to becoming a Parliamentary candidate at the 1865 election. Eventually he agreed to seek election for the Greenwich division, where so many of his cables had been made and where his name was a household word. He stood as a moderate Liberal, and found support among all classes. One of his supporters was an elderly man who used to make his way to the platform from the crowd in front, sometimes coatless, with his shirt sleeves tucked up. He usually ended his entertaining speeches somewhat as follows:—



Bright's Automatic Fire Alarm

"Now, 'ere's Surr Charles. He's a real good working man he is. If his hands ain't horny, his head's hard for work—aye, and soft for us working men—and the work of his brain has given lots of good employment, and lots of good pay to heaps of us around about here."

It turned out later that this man was a paid speaker, and had never done a stroke of work for years, preferring to live by his tongue.

Sir Charles was elected by a satisfactory majority and remained a Member during his connection with the finally successful Atlantic Cable. At this period many electrical schemes were being put forward, and the experiences of Sir Charles proved very valuable in the discussions in the House of Commons concerning them. He was specially to the fore in urging the extension of telegraphic facilities to both the East and Australia, as already related. Eventually, pressure of work prevented him from devoting sufficient time to Parliamentary duties and his Membership of the House ceased at the end of 1868, when he retired to make room for Mr. Gladstone. In the meantime he had sailed to the

West Indies on the last and most arduous piece of work in his active cable-laying career. He first went for the purpose of connecting Havana, the principal city of Cuba, with the lines in the United States of the Western Union Telegraph Company—the largest land line telegraph company in the world—and from that he went on to construct cables linking Cuba with Panama and the Islands stretching down to Trinidad. This was a vast enterprise in any circumstances. Twenty separate cables, each about 700 miles in length, were to be laid in water from one thousand to two thousand fathoms deep, and with the connecting land lines a total length of over 4,000 miles of line was required. Further extensions down both coasts of South America were also planned by Sir Charles and were eventually made, the full length of the cables and land lines thus constructed amounting to 12,000 miles.

As the work progressed, difficulties increased in number and seriousness. The sections to Cuba and Jamaica were laid with very little difficulty, but on the remaining part of the work trouble arose through the breaking of cables and the difficulties of finding lost ends. The bottom of the sea in the West Indies was found to be very rough and precipitous, being in places a nest of volcanic ridges interspersed with coral walls. Trouble arose also owing to the unhealthy nature of the climate, fever attacking the crew with fatal results. For four successive days Sir Charles had entries in his diary recording the death of one man and the funeral of another who had died on the previous day. He himself was attacked by fever and became so weak from recurrent attacks that it was necessary for him to return home for a while, his brother Edward continuing the work in the meantime.

In spite of all difficulties, however, the broken ends of cable were found and rejoined and the whole network was completed, but unfortunately not until considerably later than was expected and at an excessive cost. A good deal of the financial loss fell on Sir Charles, as he and his brother had been responsible for a large part of the capital of the company formed to establish and work these lines.

Automatic Fire Alarm

The West Indian projects were completed in 1873 and from that time onwards the interests of Sir Charles and his brother were diverted from submarine telegraphy to more general electrical engineering. Many engineers had now acquired a knowledge of cable-laying technique, and in consequence the cable manufacturing companies were in a position to contract for the complete installation of cables. On this account, therefore, Sir Charles dissolved his partnership with Latimer Clark, and with his brother set up as independent consulting engineers. In the years that followed the inventive genius of the brothers was again allowed full play, as at the beginning of their career in cable work. Of the many important inventions of this period we may particularly refer to the electric fire alarm, and the associated automatic alarm, both of which are in use to-day.

The second of these is a particularly ingenious contrivance. It consists of a coiled spring, made of brass on one side and steel on the other, so placed that expansion due to heating will bring the free end of the spring into contact with a screw terminal, thereby completing an electric circuit that causes a bell to ring. An instrument of this kind is of great value in such places as the holds or bunkers of a ship, or in corn or jute warehouses, where there is a risk of spontaneous combustion, warning being given by the alarm of any abnormal heating. At that time the insurance companies did not seem to be very favourably disposed towards this valuable invention. The manager of one of the largest companies frankly said that the use of such appliances might militate against their business, as they found that a large fire now and then actually benefited them, bringing in a shoal of new insurers!

In addition to these activities, Sir Charles became interested in mining. Before retiring from active cable work he had attempted to exploit mines of various kinds in France, Germany, and also in Somersetshire, not with the happiest of financial results. His biggest mining adventure, however, was in Servia, where he and his brother bought mines that had been worked by the Romans. These were now giving trouble to their Servian owner on account of his lack of efficient pumps. The brothers cleared the mines of water and were obtaining promising results when war broke out between Servia and Turkey and handicapped their operations so much that eventually they had to abandon the enterprise.

Sir Charles never really got over the severe attack of malarial fever that had compelled him to abandon work on the West Indian cables. During the remainder of his life he was in failing health, a state of affairs to which many financial and other worries also contributed largely. He died on 3rd May, 1888, aged 55.

A Crowded Life

These fifty-five years, however, had been crowded with pioneer achievements in practical electricity. As "*The Times*" said in its obituary notice:—"If a man's life is to be measured by the work he accomplishes, Sir Charles Bright has lived long, though he has died at the early age of 55."

The most striking and most widely-known success of Sir Charles Tilston Bright was, of course, the creation of the Atlantic cable, and this account of his life may fitly conclude with the following words from the "*Electrical Review*," written at the time of his death:

"We may, indeed, safely assume that so long as the broad Atlantic carries at its utmost depths the electric connecting chain of communication, so long will the name of the Atlantic and its first cable be connected with that of Charles Tilston Bright."

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OUR MAIL BAG

In this column the Editor replies to letters from his readers, from whom he is always pleased to hear. He receives hundreds of letters each day, but only those that deal with matters of general interest can be dealt with here.

Correspondents will help the Editor if they will write neatly in ink and on one side of the paper only.

E. Erkeleus (Amersfoort).—"And now methinks I have written enough for this time." Quite a mistake, E.E., we should have enjoyed your letter more if it had been twice as long. We are pleased to note that you are making a study of English authors and composers. We also are much interested in Cheops, Milnesia and Diatomen. Thanks for calling our attention to the Spanish pulley block. Spanner will deal with this in the "*M.M.*"

H. Bronkhorst (Swindon).—"Twenty years ago I was presented with a Meccano Outfit and I knew bliss. This year my own little son (ætat 5½) was presented with a No. 3 Outfit. I am afraid it has been a case of sonny looking on while Father 'recaptured his youth.' I happened to have my old instruction book and we have constructed weird and wonderful bridges, cranes, etc. I never could have believed the idea would have made such strides as it has done—many a part I wished for in bygone days is now obtainable and it seems impossible to improve it any more."—We were very interested in your letter and assure you there are many new Meccano parts and numerous improvements yet to come. "Wait and see," as Mr. Asquith said!

Jack Saville (Osset).—"The next time we come to Liverpool on a holiday I hope to come and see you." By all means you must call upon us, Jack, and make a tour of inspection of the Meccano factory. Glad to know that you are still busily recruiting members for the Guild.

P. F. B. Gillett (Brighton).—We think you have achieved a record in having been a Meccano enthusiast for over six years and an "*M.M.*" reader for nearly three years before you screwed up courage to write to us! Editors may be a little fierce at times, when they are unusually worried, but we assure you they are not deliberately angry with people who write to them—even though these people send terrible, trying, teasing tongue-twisters like yours:—

"I stood on the doorstep of Willie's Fish Sauce Shop,
Welcoming him in and saying,
'The Leith police dismisseth us.'"

Write again soon and a longer letter next time.

H. Stoner (Wandsworth Common).—When you suggest a competition for a "Mail Bag Hanger" is it your intention that the Editor of this column should be its first victim? Your other suggestions are noted and we have read through your list of experiments with much interest.

C. Haworth (Burnley).—"Allow me to congratulate you upon the model in this month's "*M.M.*" dealing with the link expansion gear. I have seen all kinds of diagrams and cardboard models explaining link expansion mechanism but the Meccano model beats them all." Praise from an expert is always acceptable and we value your letter. We have written you separately regarding your article.

Mrs. A. M. Weller (Billericay).—We think it was splendid of your son to send his Hornby Train Set to the Sunshine Convalescent Home and we are quite certain that the gift will have given the youngsters many hours of pleasure. At the same time we hope that this does not mean that your son is retiring from Hornby railway engineering. In any case we have a sort of fancy that later he may be seized with the old enthusiasm! Some "*M.M.s*" have been sent to the Home as you requested.

J. C. Heath (Wellington).—Your enthusiastic praise of the "*M.M.*" is very welcome. From the outset our ambition has been to make it the best boy's magazine in the world and we are sufficiently bold to think that to some extent we have succeeded. If every reader obtained nine other readers, as you have done, there would be no limit to our progress. We are interested to hear of your prize, and to note that your school, like many more of the best schools, realises that most boys prefer books on engineering and scientific matters to stories of impossible adventures.

D. Cowell (Stroud Green).—

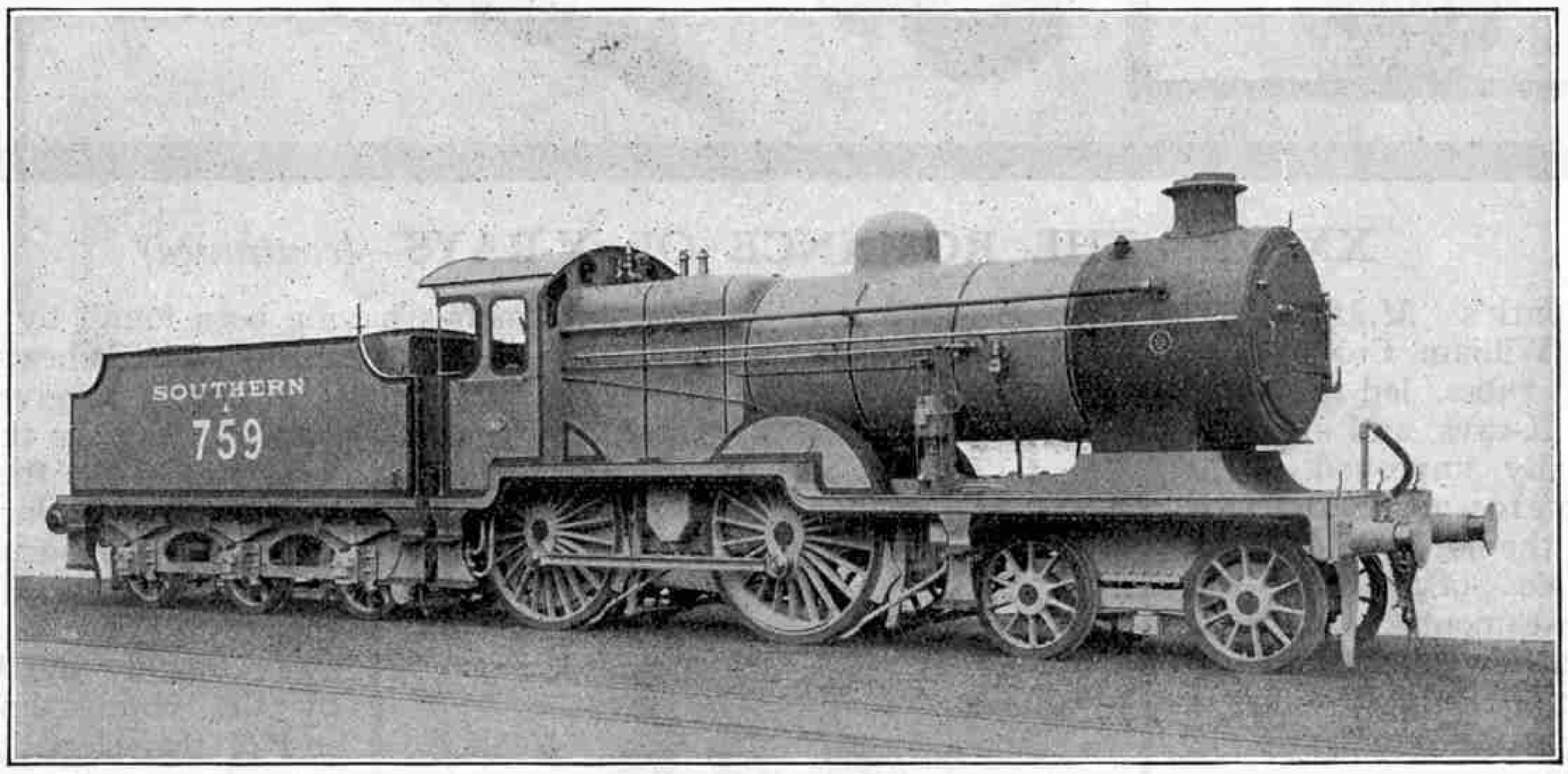
"Under the table and round by the fireplace,
On puffs the Hornby Train,
The dark eerie tunnel it quickly goes through
Then out to the daylight again."

We are sorry we cannot squeeze in more of the train's adventures, Dorothy, but we have read all your poetry with much pleasure.

Southern Railway 4-4-0 Type Locomotives

For Express Service on the Eastern Section

FIFTEEN 4–4–0 type express engines have been built by the North British Locomotive Company, Glasgow, for service on the Eastern Section of the Southern Railway. In general design the engines are duplicate with the "L" class introduced in 1914, but improvements have been made by Mr. R. E. L. Maunsell, the Chief Mechanical Engineer of the Southern Railway, in various details.



One of the 4-4-0 type Express Locomotives of the Southern Railway

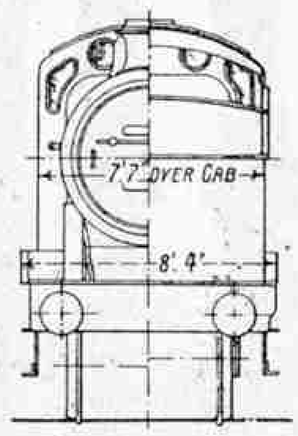
The boiler pressure has been increased from 160 to 180 lb. per sq. inch, and the cylinder diameter reduced from $20\frac{1}{2}$ in. to $19\frac{1}{2}$ in., so that the tractive effort is not appreciably affected.

The Stephenson link motion has been entirely remodelled and the valve travel increased to $5\frac{3}{8}$ in. in full gear, the lap being increased from $\frac{7}{8}$ in. to $1\frac{3}{16}$ in.

The engines have the "Maunsell" type superheater with shifting valves and the hydrostatic sight feed lubricator having separate condenser for cylinder and valves.

The smoke-box arrangement has been redesigned and a standard chimney fitted. The flat-sided tender with enhanced brake power is also duplicate with the 2–6–0 type engines of Mr. Maunsell's design.

Particular care has been taken with the rearrangement of the cab and footplate, resulting in improvement for the comfort and convenience of the enginemen. The cab roof has been extended backwards, side windows provided, and the large tool boxes behind the splashers have been replaced by tip-up seats.



End View

The lighting in the cab is excellent and the look-out improved. Such fittings as the vacuum brake ejector, steam reversing gear control and sight feed lubricator have been carefully located in the most convenient positions for observation and operation. Hand sanding gear is provided to each pair of coupled wheels. The Davies & Metcalfe exhaust steam injector is fitted on the left-hand side.

These engines, which are numbered A.753 to A.759 and A.782 to A.789, are mainly intended for the Charing Cross, Folkestone and Deal, and the Charing Cross and Hastings services.

The accompanying diagram gives an elevation and also shows the dimensions of these locos. The leading particulars are as follows.

The boiler, which is of the Belpaire type, has a working pressure of 180 lbs. per sq. in. Its barrel diameter outside the front ring is 4 ft. $10\frac{7}{8}$ in. and the barrel diameter outside the back ring is 5 ft. The length of the barrel is 11 ft. 5 in. and the width of the fire-box shell 4 ft. $\frac{1}{2}$ in. its length being 7 ft. 5 in.

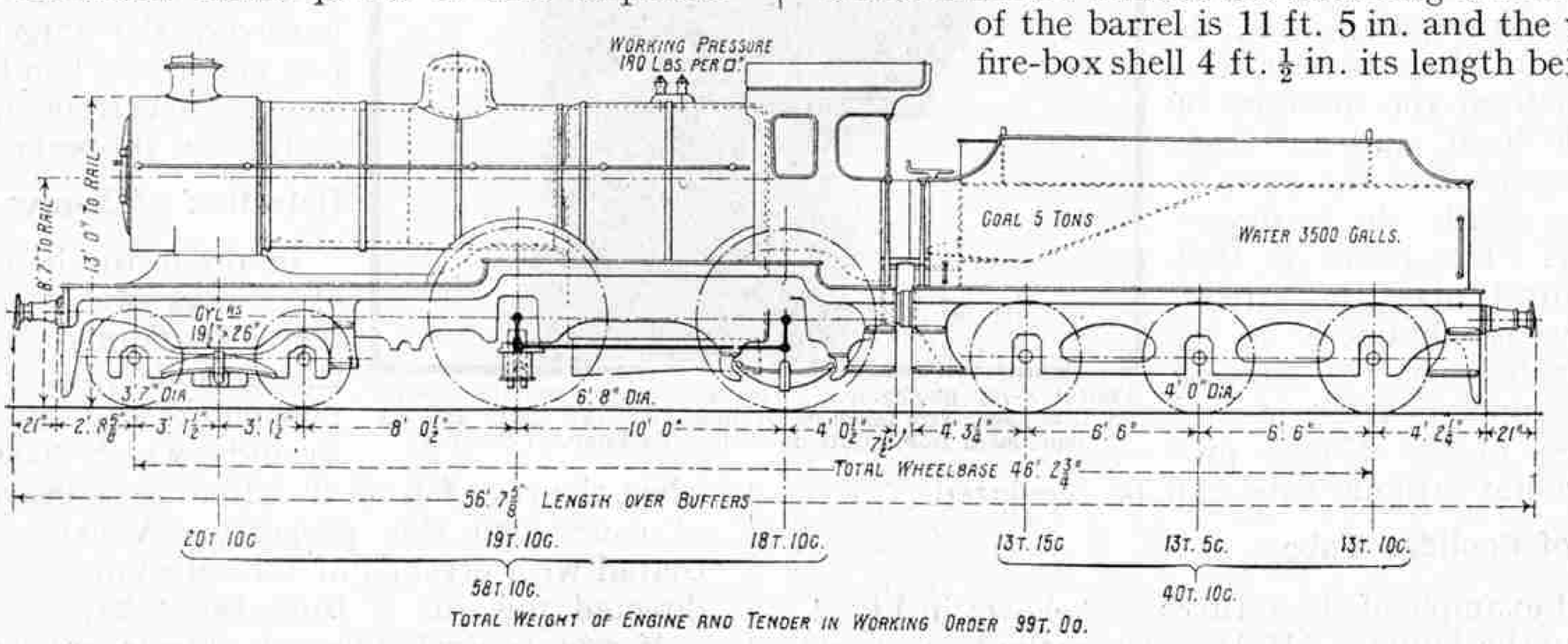


Diagram and Leading Dimensions of Southern Railway 4-4-0 Type Express Locomotive

There are 169 tubes of $1\frac{3}{4}$ in. diameter and twenty-one tubes of $5\frac{1}{4}$ in. diameter.

The total heating surface of 1,407 sq. ft. is made up as follows: Fire-box

(Cont. on p. 183)

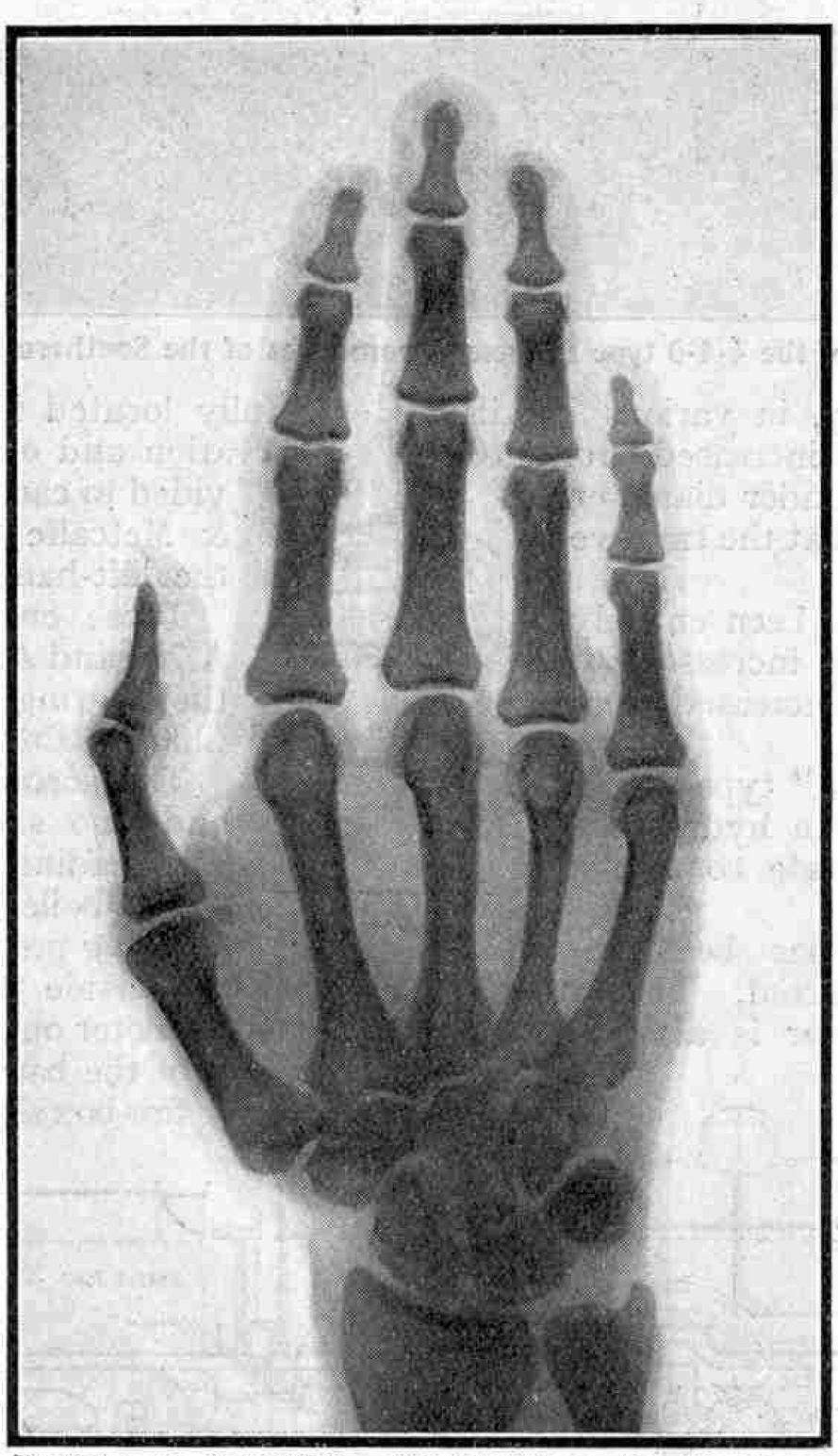
Electricity

XXXIII. THE ROMANCE OF X-RAYS—(*continued*)

IN last month's "*M.M.*" we saw how the discovery by Sir William Crookes of the cathode rays in vacuum tubes led up to the discovery of the Röntgen or X-rays, and also how the first crude tubes were gradually improved. The latest development in this direction is the hot-cathode tube, the principle of which was explained last month. We must now give a few details of the construction of the highly efficient hot-cathode tubes designed by Dr. Coolidge.

In order to drive off the electrons produced from the hot cathode, high voltages, even up to 200,000, are used in the Coolidge X-ray tubes, as the more violent the bombardment of the target the more penetrating are the X-rays produced. A further advantage resulting from the use of high voltages is that the pressure may be reduced to a very low value, thus avoiding the necessity for regulating devices. According to the makers of the tubes, the pressure in them is as low as one thousandth of one millionth of atmospheric pressure!

This is a great gain, and it is due to the fact that the electrons are derived from the material of the cathode itself, and not from any gas contained in the tube as is the case with the ordinary X-ray tube. The result is that greater control over the stream of electrons is obtained, as its velocity can be varied by varying the voltage applied. Consequently the hardness of the X-rays produced by a hot-cathode tube can be regulated.



Typical X-ray photograph. This photograph, and the one on the next page, were taken on Wellington X-ray plates and are reproduced from prints on Wellington Enammo Bromide

Operation of Coolidge Tube

A typical example of these tubes was shown in Fig. 4, on page 16 of the January "*M.M.*" The cathode is a spiral of tungsten wire enclosed in a cup of molybdenum, these rare metals having been found by trial to be the most suitable. The tungsten wire is heated by a special electrical circuit, thus causing it to give off electrons. These are driven off at great speed by the high voltage used, and strike the target which, in this particular type, is a tungsten stud embedded in a block of copper. The purpose of the copper block is to conduct away quickly the heat produced by the bombardment, and the end of this electrode outside the tube has cooling fins to assist in the process.

For these modern tubes the induction coil as a source of current is inadequate, and in most cases a "step-up" transformer working from the electric light mains is used. Such a transformer works with alternating current and, as the output is also alternating, a mechanical rectifier driven by an electric motor is necessary. A point of interest is that the Coolidge tube is an instrument like a wireless valve, which will only allow a transmission of current in one direction, and is thus self-rectifying. If, however, the target becomes so hot under the bombardment that it emits electrons itself, the self-rectifying property is lost.

Detection of X-rays

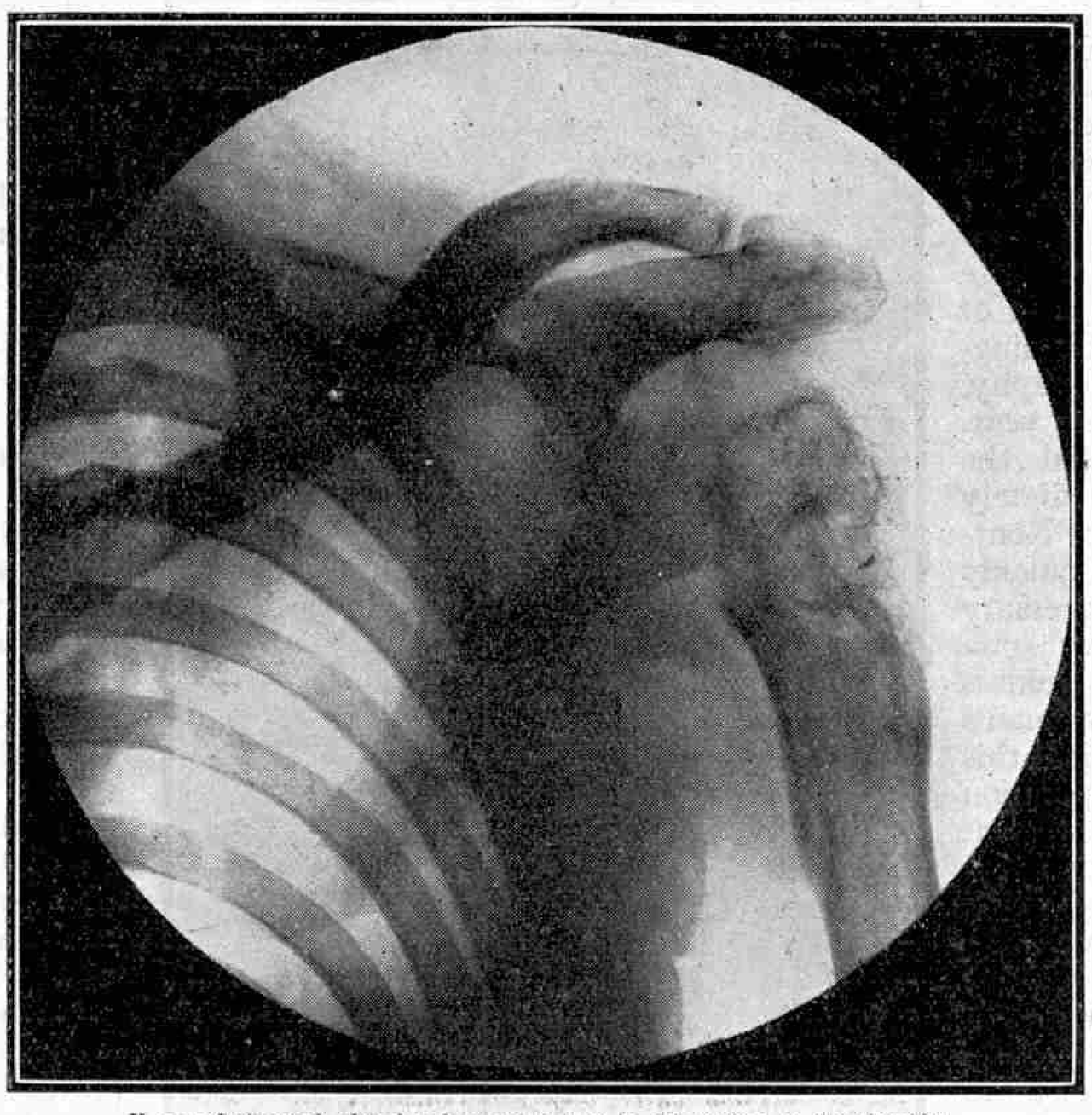
In order to show the presence of X-rays we may employ the method adopted in the case of the cathode rays, that is by the phosphorescence of barium platinocyanide, which gives a green glow when the rays fall on it. Röntgen's discovery was due, of course, to this property. A cardboard screen is coated with crystals of this substance and the rays are directed towards it from the tube.

If now several different objects are held in front of the screen, it is found that some of them allow the

rays to pass through to illuminate the screen, while others, being opaque to the X-rays, throw a shadow when placed in the path of the rays. If a hand is held in front of the screen, the flesh will give a faint shadow and the bones a much deeper one, the latter being much more opaque to the rays. Generally speaking, substances such as wood and paper, and metals of low atomic weight such as aluminium and zinc, are easily penetrated by the rays, while metals of higher atomic weight, such as platinum and lead, are more opaque.

X-ray Photography

For most X-ray work, however, a photographic method of detection is employed. An X-ray photograph is really a shadowgraph, as the rays that affect the film are those that are stopped in it. Such photographs may be taken on ordinary plates, but for good class work plates specially made for the purpose are employed. The emulsion of an ordinary photographic plate is only partially opaque to the rays, so that while some of these are stopped by it, others pass straight through. The silver bromide in the emulsion is not affected by the rays that pass through, which means that a great deal of energy is wasted.



X-ray photograph showing bone structure in the region of the shoulder

A larger proportion of the rays may be stopped by utilising very thick films of emulsion, preferably on celluloid, which has the advantage that it can be coated on both sides. Practical difficulties that arise in the subsequent processes of developing, fixing and washing limit the thickness of film that can be conveniently used. Another method employed with the object of increasing the sensitiveness of X-ray plates is that of coating them with an emulsion containing salts of certain metals that are highly opaque to the rays.

The action of the X-rays on the emulsion of the photographic plate is not rapid and, as we shall see later, it is often of the utmost importance that exposures should be as short as possible. A very interesting method has been devised to achieve this. A cardboard screen is coated on both sides with a film containing one of the substances that have the property of giving off visible light when the X-rays fall on them. Barium platinocyanide we have already seen to be one of these, but for this purpose the best is calcium tungstate, because its glow is specially rich in violet or ultra-violet light, and therefore affects photographic plates strongly.

This intensifying screen is placed with its sensitive surface in close contact with the emulsion on the plate or, in the case of a celluloid film coated on both sides, the film is squeezed between two of these screens. Thus the action of the X-rays is reinforced by the action of the light waves produced from the calcium tungstate. It is essential for the contact between the screen and the photographic emulsion to be perfect, as otherwise the shadow formed would be too diffuse.

Nature of the Strange Rays

The exact nature of these strange rays has been a subject of controversy, as was the case with the cathode rays. At first it was thought that they could not be of the nature of light, as it did not seem possible to reflect them from any kind of surface, or to get them to bend, or be refracted, on passing from one substance to another, as is the case with light. It is now agreed, however, that they are actually waves in the ether just as are light waves.

Everybody is familiar nowadays with the idea of the ether, which acts as a carrier of wireless waves as well as of the waves of light. Wireless waves, light rays, and X-rays are all electro-magnetic waves in the ether, differing considerably however in their lengths. Wireless waves are the longest of all. Light waves vary greatly in length, the wavelength of what we call blue rays being shorter than that of the red rays, while there are also certain invisible rays, among them being the ultra-violet rays, which have a still shorter wavelength.

The X-rays are the shortest of all, those of the greatest practical value having wavelengths so short that the number of waves in each metre of their path would be measured in millions of millions! The wireless waves in common use vary in length from 10 metres up to several thousand metres. On comparison of the wavelengths of the two sets of rays, therefore, it will readily be understood that they will have vastly different properties.

X-rays can be both reflected and refracted by the use of suitable surfaces, but owing to their short wavelength it is difficult to demonstrate this. Their short wavelength is also the reason of their ability to penetrate solid substances through which ordinary light cannot pass. The hard X-rays, that is the more penetrating kind, have been found to be those of the shortest wavelengths, and during recent years the aim of X-ray workers has been to design apparatus to give still shorter and more penetrating rays, the most outstanding development being the Coolidge hot-cathode tube already described.

Unexpected Dangers Revealed

The discovery of the X-rays aroused keen interest among scientists and the general public, and lectures

and demonstrations were very numerous and attended by large audiences. A very popular experiment in these demonstrations was one in which some person, usually the operator, interposed one hand between the X-ray tube and the fluorescent screen in order to show the bones, and as a result many operators exposed their hands to the rays for long periods. Alarming results followed. Mysterious skin diseases appeared, somewhat of the nature of burns, which were grouped under the name of X-ray dermatitis. Before the origin of these troubles was traced, many really serious cases of injury occurred, involving the formation of ulcers and cancerous growths. Finally it was recognised that the X-rays were very dangerous indeed unless complete precautions were taken.

The most noteworthy of these cases of X-ray injury is that of Dr. J. Hall-Edwards of Birmingham, a pioneer in radiography, who died in August of last year. Dr. Hall-Edwards realised the value of the rays immediately upon the announcement of Röntgen's discovery. He quickly gathered together the necessary apparatus, and was very soon able to demonstrate its usefulness by locating a needle in a woman's hand and extracting it, this being the first surgical operation in which X-rays played a part. Subsequently he extended the use of the rays in many ways. He carried out very valuable work with a specially-equipped ambulance in the Boer War, and later he interested himself in the application of radiography to industrial work.

Photograph of leg bone showing serious fracture

A Martyr to Science

Dr. Hall-Edwards' record of work would have been remarkable under any circumstances, but he paid the penalty for working with the rays at a time when their dangers were unknown, and became a victim to the dreaded X-ray dermatitis. He carried on his work under the handicap of the disease itself, to which was added the loss of the fingers of his right hand and eventually of his left arm. His dauntless spirit refused to submit, however, and he was inspired by the great thought that he was collecting, from his own painful experience, information that would help greatly in the discovery of methods to enable the rays to be used with safety.

One specially important fact thus demonstrated was that the longer and less penetrating waves were the more dangerous. These are now almost always eliminated by using a screen of aluminium or copper of such a thickness that only the less dangerous hard rays can pass through it.

Methods of Protecting Operators

For general protection from X-rays the usual material employed is lead, a thickness of 3 m.m. of this heavy metal being sufficient to reduce the intensity of the rays to one ten-thousandth of their original value. Metallic lead sheet is often used, but lead-rubber is found more convenient for many purposes. This is simply rubber containing a proportion of lead compounds, its effectiveness being from one-quarter to one-half that of lead alone. The X-ray tube is enclosed in a case of ebonite or wood, lined with lead-rubber and provided with a diaphragm to enable the radiations to be cut off entirely when not required.

The operator generally stands behind a screen lined with lead-rubber and provided with a window made of glass containing lead compounds, and for further protection wears an apron and gloves of lead-rubber and a mask with lead-glass eye-pieces. The patient also is protected, but of course must have the rays applied somewhere. All exposures are carefully regulated and kept within the limits of safety, and deep-seated organs such as the heart and kidneys are treated by several short exposures made through different parts of the surface of the body, so as to avoid over-exposing any portion of the skin to the rays.

The protective measures now taken are so effective that one expert has said that any man who burns a patient is a rogue, while if he burns himself he is a fool! Even now, however, it is doubtful whether we know the real extent of the possibility for harm of the X-rays to those using them, owing to the slowness with which symptoms develop. From burns on the skin we may claim to have obtained efficient protection, but the effect of the very hard rays now used is not clearly understood, and in one recent case, that of Dr. Ironside Bruce, radiologist to a London hospital, death was attributed to anæmia, resulting from the action of the hard rays on the internal organs.

New Eyes for the Surgeon

The application of X-rays to the study and cure of disease has grown to enormous dimensions and further advances are being made continually. The first and most obvious use is in the study of bone structure and diseases, and in determining the position of foreign objects in the body.

Take the case of a man who has been shot, the bullet remaining in the body. Two X-ray photographs, or "skiagrams" as they are called, taken from different directions, or a stereoscopic skiagram, will enable a surgeon to come to a definite conclusion as to the exact whereabouts of the bullet, and thus help him to decide whether he shall try to extract it or not. Another example of this kind is the case of a fractured bone having been wrongly set, which does sometimes happen, skiagrams enabling the best mode of remedying matters to be found.

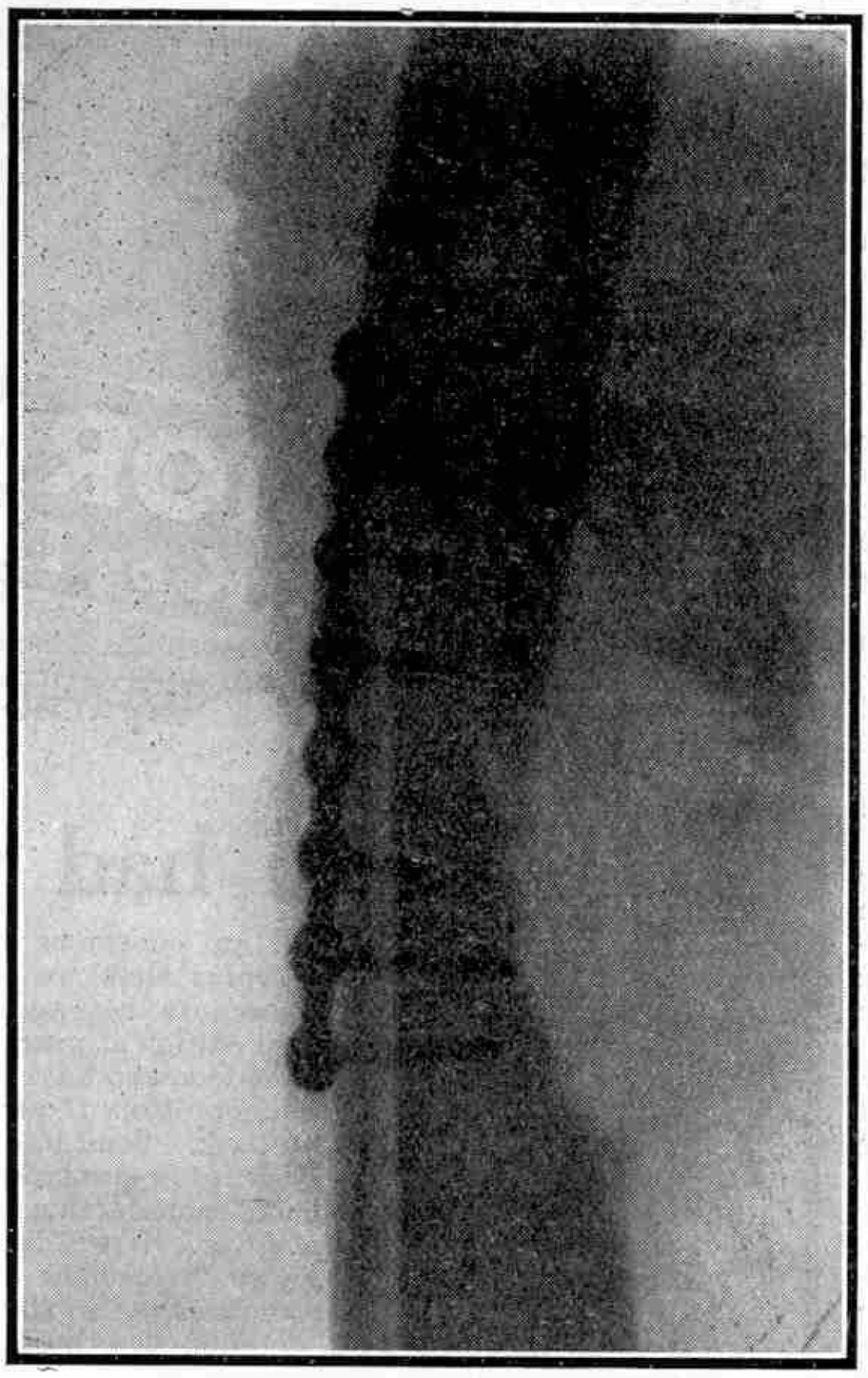
Bone Repair with Aid of X-rays

A striking instance of this is illustrated by the

accompanying X-ray photographs of a broken leg. The patient was a forward in a well-known Rugby League football club and had the misfortune to have his leg broken while playing. The bones were set but the leg did not mend properly, either because the setting had not been successful or because movement took place too early, and it was therefore decided to have an X-ray photograph taken. The result is seen in the photograph on page 114, the cause of the trouble being immediately obvious.

The surgeon subsequently in charge of the case, a Liverpool specialist, very skilfully brought the ends of the bone together and riveted a sterilized silver plate into the sound portions of bone. This is clearly shown in the photograph on this page, which also shows a gap on the right where the bone had broken into splinters. The patient progressed slowly but surely, and his case is a splendid example both of the wonderful value of the X-rays and of the skill that has been developed by modern surgeons.

The development of X-ray tubes producing harder rays has enabled doctors to make use of them to examine deep-seated organs such as the heart, using both the screen and photography. One special form of X-ray apparatus has been devised by means of which an outline of the heart's shadow may be obtained with great accuracy, enabling valuable evidence of disease to be obtained in earlier stages than by other means, thus greatly facilitating treatment. An interesting use made of the screen is to show the movements of the diaphragm that separates the chest from the abdomen.



Broken bone re-set and fixed in position by silver plate

Watching the Passage of Food

The most remarkable development in the application of the X-rays in medicine is probably their use in examining the alimentary canal, through which food passes. For this purpose what is known as an "opaque meal" is given to the patient. This is generally a mixture of sweetened arrowroot, cocoa, and barium sulphate, with milk and water, heated and stirred until it thickens.

The barium sulphate is the important substance so far as the X-rays are concerned. Barium is a metal of high atomic weight, and its compounds therefore will give a very dense shadow in a skiagram, with the somewhat surprising result that the passage of food containing it can be followed quite easily. Very valuable information is thus placed at the disposal of doctors, both as to the presence of unwanted bodies such as fish bones or pennies, which children have a habit of swallowing, and of abnormal conditions in the interior of the body generally. Foreign objects are usually shown quite plainly by the curl in the dense shadow cast by the opaque food as it passes round them.

In addition to their employment as guides in the study of disease, great use is made of the X-rays as actual curative agents. They are applied in small and carefully regulated doses to the treatment of skin diseases and also to the treatment of ulcers and cancer. Probably they cannot replace surgical operations in the treatment of the latter, but they find particularly important use in the prevention of the spread of new growth after a successful operation has been performed.

A good deal of the work formerly performed by X-rays, such as the cure of rodent ulcers, is now more conveniently carried out by the rays from radium, some of which are practically identical with X-rays, but of shorter wavelength and greater penetrating power. For action of this kind on internal organs, however, Coolidge tubes producing very hard X-rays are being more and more relied on.

The nervous system in general is not sensitive to X-rays, so that treatment is not complicated by any fears of nervous shock. The rays seem to have a stunting effect on the growth of young animals, and this action extends to growing cells in general. Sweat-glands and hair follicles have their growth arrested and may even be destroyed by the X-rays, thus enabling such diseases as ringworm to be cured. If the action is prolonged total baldness results.

How the Rays Cure Disease

When X-rays pass through any substance they penetrate here and there into atoms and expel electrons from them. This "ionising" action, as it is called, occurs for instance in the emulsion of a photographic plate and is the cause of the stoppage of the X-rays that do not pass through. It is believed that the curative action of the X-rays on ulcers and cancerous growths is due to a similar action in the tissues penetrated by them, whereby electrons are produced, the absorption of which is really responsible for the effects. This suggests that recent developments of the Coolidge tube may find a use in surgical work.

It was discovered long ago by Heinrich Hertz, the wireless wave pioneer, that the cathode rays, which we have seen to be composed of electrons, will pass through thin sheets of metal, and in 1894 Philip Lenard, a Hungarian scientist, had obtained electrons in the air by allowing cathode rays in a vacuum tube to fall upon an aluminium window. This was one of the experiments relied upon by the German scientists to prove that the cathode rays were of the nature of light. That a material particle could thus penetrate a sheet of metal was an idea that most people of that day were hardly prepared to accept, and even nowadays, when we are more familiar with the penetration feats of the rays from radium, the idea is somewhat startling.

Actually it has been discovered that solid substances, even heavy metals, are not nearly so solid as they look. They were formerly regarded as solid because they were

composed of tightly-packed atoms, but now we know that the atoms themselves are mostly space. They consist of a nucleus around which electrons revolve in orbits, somewhat as in a miniature solar system, and as the space occupied by a whole atom is enormously greater than the space occupied by an electron—the "fly in a cathedral" comparison of the previous article will be remembered—there is plenty of room for the latter to pass through, not merely one but a succession of atoms.

Electrons with a speed of 150,000 miles a second

Coolidge removed the target and made a window of nickel foil at the end of one of his tubes, so that the cathode rays could pass through the nickel. The nickel foil used was only one two-thousandth of an inch in thickness, and to prevent it from crumpling up under the pressure of the atmosphere it was necessary to reinforce it by a perforated block of molybdenum, which had the honeycomb appearance characteristic of the radiator of a motor car. Even then the difference between the atmospheric pressure outside and the nearly perfect vacuum inside the tube bent the foil in the openings of the molybdenum block.

By using 350,000 volts pressure between the electrodes in this tube, Coolidge obtained a stream of electrons having a speed of 150,000 miles a second and capable of penetrating as much as 2 ft. through the air, whereas Lenard's tube produced electrons capable of travelling a few millimetres only, after passing through the aluminium window. The air outside the nickel window is rendered strongly phosphorescent by the rays, a splendid purple glow making the extent of their passage through the air readily visible.

The electrons of such a stream as this are numbered in billions and, on account of their great speed, will possibly be more active than those produced by X-rays, so that their employment as curative agents may prove valuable. So far, little is known of their action beyond such facts as that the ear of a rabbit developed a scab in a few days after exposure to the electron stream for one second, followed by loss of hair and a subsequent profuse growth of long snow-white hair. If the cathode rays do prove of value in this respect it will be only in the treatment of skin ailments, as they cannot penetrate the skin to any great depth. The X-rays will always be used for any other purposes as they are able to plant the action at any required depth in the body.

NEXT MONTH:—

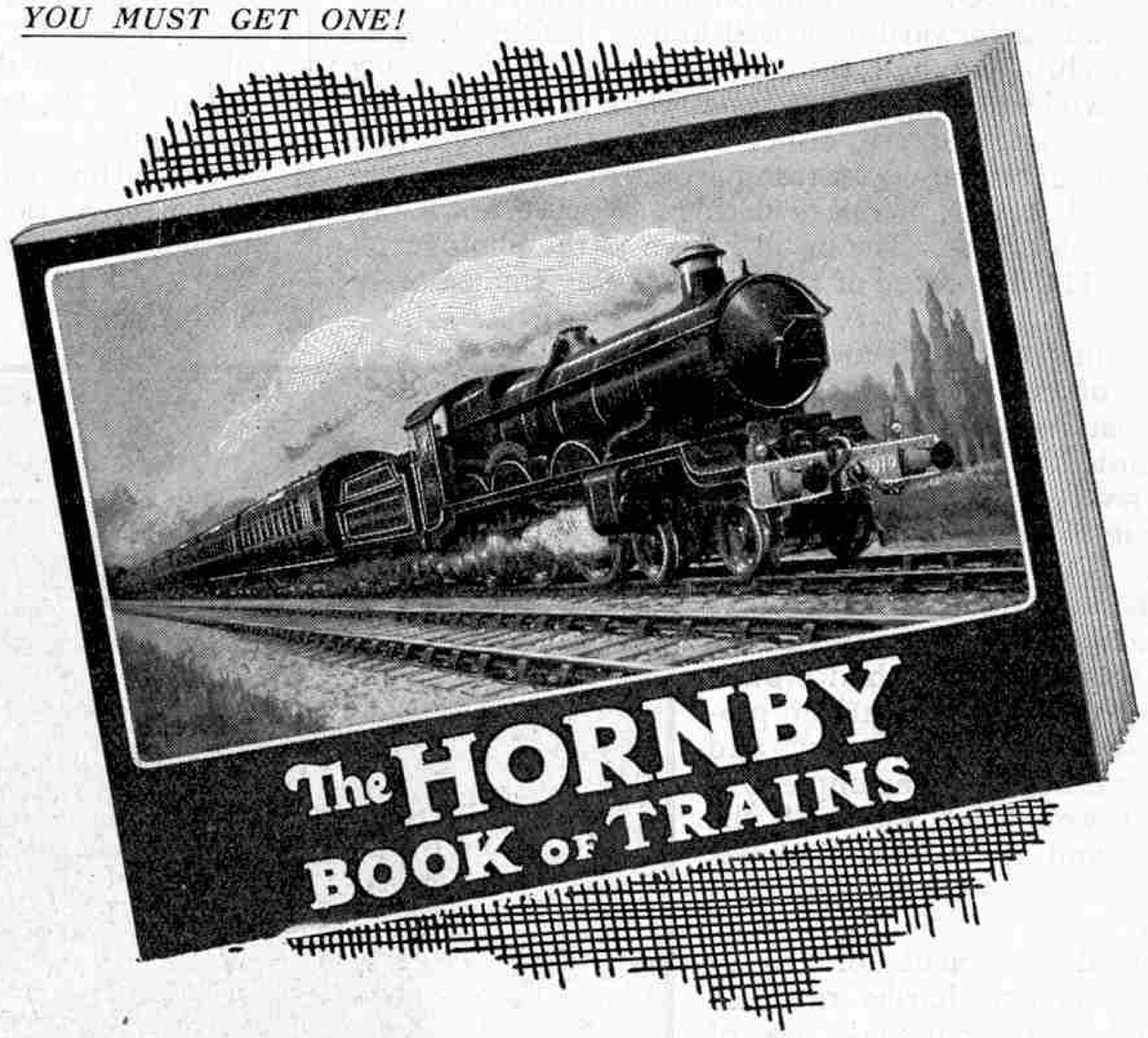
X-RAYS IN INDUSTRY

The Meccano Jerseys

No doubt each of the many boys who are recruited to the Meccano hobby at this season of the year will want a Meccano jersey, since this has become the distinctive dress of Meccano boys. For many years, in all the Meccano advertisements Dick has been shown in his check jersey, which is generally acknowledged to be the most serviceable and comfortable rig-out, not only for model-building but also for every-day wear.

Meccano jerseys, made by the Jaeger Co., are obtainable in a large range of colours, and full particulars appear on page 170. It is well to remember that the Jaeger Company also supply every boy's every need through every season! On receipt of a post-card Jaeger Co. Ltd. will be pleased to send a representative catalogue post free to any reader mentioning the "*M.M.*"

YOU MUST GET ONE!



Have you had your Copy?

There has been such an enormous demand for the 1926 edition of *The Hornby Book of Trains* that we were soon sold out. So many readers were disappointed because they were unable to secure copies that we have decided to print a final edition at once. Copies will be available in two or three weeks and those readers who have not already had one should send in their order at once for a copy from the final edition. A paragraph below tells you how to order the book. Send to-day or it may be too late!

This fine book is beautifully printed on art paper and contains 48 pages (11″ × 8¼″). A splendid reproduction of the "Cornish Riviera Express" at speed is printed on the cover. It will be remembered that in the original edition, published in 1925, we devoted the first half of the book to a story of the locomotive from its earliest days. In the new edition the same amount of space is occupied by a detailed description of the locomotive and other interesting railway mechanisms.

The following are the chief subjects dealt with:—

THE BOILER AND ITS PARTS.
HOW THE ENGINE WORKS.
HOW AND WHY STEAM IS SUPERHEATED.
RAILWAY BRAKES.
THE STORY OF BRADSHAW'S RAILWAY GUIDE.
HOW TRAINS ARE LIGHTED AND HEATED.
SIGNALS AND SIGNALLING.

FULL PARTICULARS OF THE NEW HORNBY TRAINS

The second half of the book is again devoted to a beautifully illustrated description of all the Hornby Trains and the latest additions to the Hornby Series of Rolling Stock and Accessories, including the new "M" trains, Metropolitan Trains and the "Blue" Train. The illustrations are printed in four colours and the reproduction of the Hornby Trains is most realistic.

HOW TO ORDER THE BOOK

Address your orders to "Hornby Book," Meccano Limited, Binns Road, Liverpool, and please write your name and address clearly.

The price of the book is 3d. (post free), and a remittance for this amount should be sent in stamps. There is no reduction if more than one copy is ordered.

Orders will not be acknowledged but copies will be sent as soon as they are received from the printer. Orders will be executed in the rotation received and when this, the final edition, is exhausted, no more books will be printed. If any orders are received too late to be executed readers will be advised and their remittances returned (less postage).

ORDERS FROM OVERSEAS

A special edition of "*The Hornby Book of Trains*" was printed for Overseas readers. Readers overseas who require copies should address their orders to the agency in their own particular country, listed in the next column.

Readers living in countries other than those mentioned should order from Meccano Ltd., Binns Road, Liverpool, and send a postal order for 6d. with their order.

The price for all books ordered from outside the United Kingdom is 6d. each.

AUSTRALIA. E. G. Page & Co., 52, Clarence Street, Sydney, N.S.W. P.O. Box 1832.

NEW ZEALAND. Browning, Ifwersen Ltd., P.O. Box 129, Auckland.

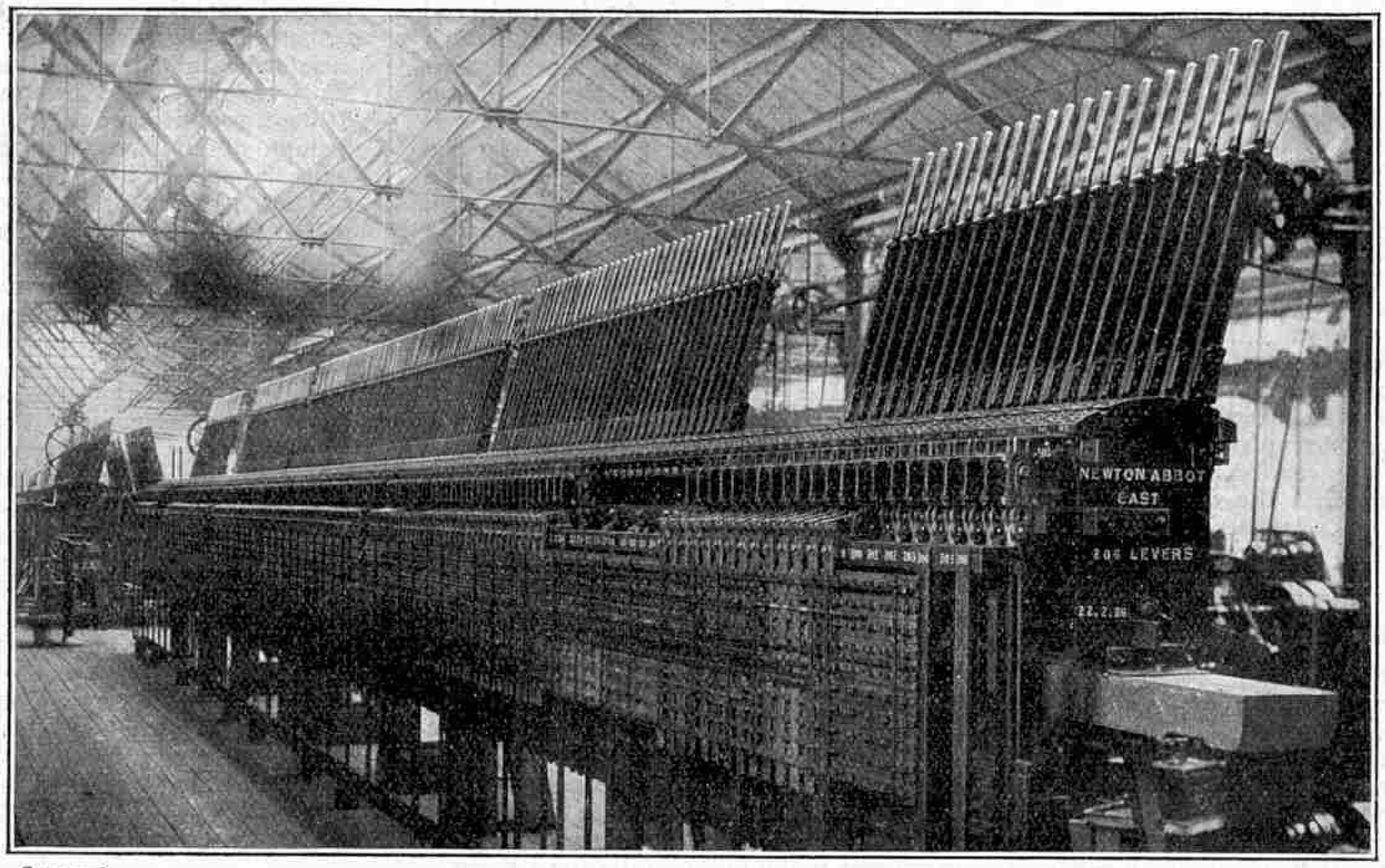
SOUTH AFRICA. Arthur E. Harris (P.O. Box 1199), Textile House, Von Brandis Street, Johannesburg.

Your last chance to secure a copy!

New Signal Box: 206 Levers

Giant Locking Frame for Newton Abbot

IN the early days of railways the signals and points were operated by single levers, fixed on the ground at the particular point or signal to be operated. As railways became more complicated and traffic increased, it became necessary to concentrate these levers in one machine so that a number of them could be conveniently controlled by one man, and to enable them to be interlocked so that conflicting signals and points could not be operated at the same time.



Courtesy ["*G.W.Rly. Magazine*"

The New Frame for Newton Abbot East Signal Box as erected at the Great Western Railway Signal Works at Reading

The new locking frame for Newton Abbot East signal box, which is here shown, has a larger number of working levers for mechanically operating the points and signals than any other frame on the Great Western Railway, the total number being 170 and the total capacity of the frame being 206 levers. The pitch of the levers is 4 in. and the total length of the frame is 68 ft. 8 in.

One of the first essentials of the locking frame is that it should provide a powerful leverage to enable the signalmen to operate points and signals easily. It will be understood that a considerable amount of power is required to operate points that may be situated 350 yards from the signal box and signals sometimes over 1,000 yards—the leverage in the case of points is, in fact, about 8 to 1 and for signals the ratio is rather less.

The interlocking on a frame of this size is of course a very complicated affair. It is operated by means of cams attached to the levers and transmitted to the vertical panels or trays that may be seen in the photograph where the locking is actually done.

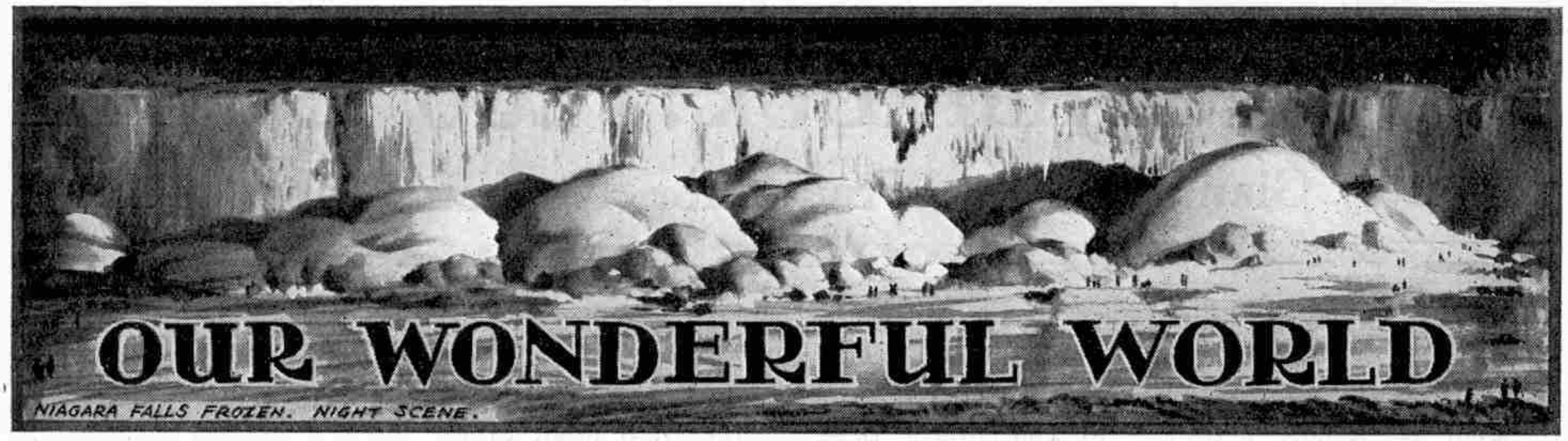
There are about 1,300 locks in this frame and these can be cleaned and examined at any time without interfering with the signalmen who work on a floor above, about level with the quadrant and the lever.

The total size of the signal box into which this locking frame is built is 80 ft. × 14 ft., the floor upon which the signalmen stand to operate the levers being 14 ft. above the lines.

In addition to the mechanical locks mentioned, there are fitted to the frame a number of electrical locks, provided for the following reasons. The platforms for the new station at Newton Abbot are extremely long—1,400 ft. to be exact. The East signal box, about which we are writing, is situated at one end of the station some little distance from the end of the platforms and another signal box is provided at the other end. As it would be very difficult for a signalman to see whether all six platform lines were clear, these lines are track circuited. That is to say, they are electrified, and when a train is on the electrified portion the electric current in the rail is dispersed in the body of the train, thus breaking down the electrical circuit which has been keeping the signal lever free. This allows the armature to drop in the electric lock that is fixed on the locking frame. This locks the signal lever and so prevents the signalman from lowering the signal for another train to enter the line that is occupied.

It may be of interest to say that certain signals and points, which are situated a long way from the signal box in the middle of the platforms, will be worked by electric motor, controlled, of course, by levers in the locking frame.

The new installation is part of the scheme of rebuilding and reconstruction that is in hand at Newton Abbot as a consequence of a fire that practically destroyed the whole of the station buildings. The booking hall, waiting rooms, refreshment bars, footbridges and platform roofs have all been rebuilt, and a new electrically-driven pump has been installed to replace the steam-driven pump previously in use.



Why Lead Wire Glows

It is a curious fact that lead wire when heated by electricity, glows, for no substance glows below a temperature of 500° Centigrade and the melting point of lead is 327° Centigrade. The explanation is, that actually the glowing lead has become liquid but is held in its shape as wire by a thin film of oxide that has formed around it. This has an extremely high tensile strength and, as it were, forms a jacket which retains the metal.

The truth of this assertion can be proved by experimenting with the lead wire in hydrogen or nitrogen thereby excluding oxygen. In these circumstances no protecting film of oxide can be formed and it will then be found that the wire will melt and run as soon as a temperature of 327° is attained.

* * * *

Silk from Shells

During recent years the production of the so-called artificial silk has increased with remarkable rapidity. Previous to the War, Germany supplied one-quarter of the world's requirements, but she has been left behind and to-day is able to supply only one-tenth. It is not surprising, therefore, that German chemists have been seeking new methods of production.

An important discovery has been reported recently from the Kaiser Wilhelm Laboratory for Fibrous Material Chemistry. After several years of experimental research, two chemists, it is stated, have succeeded in producing artificial silk from "chitin," a white, hornlike substance that forms the outer covering, or shell, of various spineless insects and shell fish. This substance is extremely durable and it is claimed that threads of the new material are even stronger than those of the pure article. Details of the process have not been divulged.

* * * *

A Plague of Blackberries

Blackberry hunters would find a paradise in the South Island of New Zealand, where it is asserted that the berries grow in the main streets of the country towns on the west coast. But they are not wanted there. Some sixty years ago somebody imported a blackberry bush and thus was an innocent cause of great loss to the farmers of the island, for now the bushes have spread until they cover nearly 100,000 acres of valuable dairying land. The New Zealanders say that they have only one blackberry bush in the island, but that it is 200 miles long!

When a plague of prickly pears over-ran millions of acres in Australia, cochineal bugs were imported as one means of getting rid of the obnoxious plant, and similar methods are to be tried in New Zealand. Finding the right insect is difficult, however. As the blackberry belongs to the same family as the apple, pear, plum and apricot, it is only too easy to do more harm than good, and before introducing any of the insects that feed on the blackberry they will all be carefully tempted with the other plants. These tests will go on until the authorities are satisfied that they have found an insect that likes blackberry but has no taste for pears or apples, and then it will be let loose upon the unwanted bushes.

This is another example of the accidental disturbance of the balance of nature, a problem that is continually being encountered. The prickly-pear plague in Australia has already been mentioned, and the history of the rabbit pest in that continent is well known. A very striking instance is given by the trouble experienced in California with a scale insect accidentally introduced on young lemon trees brought from Australia. The scale quickly spread until it became a grave menace, and all mechanical means of destroying it proved unsuccessful. Finally, search was made in Australia for a natural enemy of the scale, and a larger insect was found that depended on it for food. This was introduced into California and quickly made an end of the scale, but was too successful, and began to die off itself for lack of food. The end of the story was that colonies of both were established, so that either one or the other could be supplied as desired in any particular district to preserve the balance.

* * * *

New Chemical Element

The discovery of a new chemical element is not an easy matter nowadays when the few remaining undiscovered are very obscure, so that it is not surprising that some doubts exist about the latest discovery in this connection. Professor Rolla, of Florence, claims to have identified a new element, and to have found it to be one of a group known as the rare earth metals, the best known example of which is thorium, the radio-active metal that enters into the composition of the material used for making gas-mantles. According to Rolla, his discovery is the element with atomic number 61, but Urbain, the well-known French chemist, also has claimed to have isolated the element with atomic number 61, so we must wait for further details before we can decide which of the two has really made the discovery.

As the number of elements known increased rapidly in the earlier half of last century, it was recognised by Newlands in England and Mendeleëf in Russia that, by arranging them in the order of their atomic weights, they fell naturally into groups of similar elements. There were gaps in some of the groups, and Mendeleëf not only boldly prophesied that elements with atomic weights to fit into the gaps would be discovered, but also predicted many properties of the undiscovered elements—predictions that were completely justified by later discoveries.

There were one or two difficulties in Mendeleëf's arrangement of the elements, but these disappeared when Moseley, an English scientist unfortunately killed in the War, showed that, instead of atomic weights, what he called atomic numbers should be used. These are simply the number of electrons, or negatively-charged particles, contained within the atom. In the hydrogen atom there is only one electron and its atomic number is one, while uranium has an atomic number of 92. No element is known with more electrons within the atom, and of the intervening possible elements only three now remain; or two if the discovery of the one with atomic number 61 is confirmed.

* * * *

A Free Supply of Gas

For over 16 years the people of Johannesburg have had within easy reach an ample supply of gas at a good working pressure, and have let it go to waste. Now they have awakened to the fact, however, and are taking steps to collect and use this free supply.

The gas is at Gruisfontein, 60 miles to the east of Johannesburg, where it was discovered during the boring of a hole by the Government with quite another purpose in view. Ever since it first stopped boring operations by driving the workmen away, the gas has been escaping into the air, making life nearly impossible in the neighbourhood. The supply must be enormous, for when the top was closed and fitted with a tap the pressure was found to be 25 lb. to the square inch, in spite of probable escapes through the ground elsewhere. The Johannesburg Municipality are now to embark on a scheme for storing and distributing this gas.

Gas of this kind is not by any means uncommon, particularly in the United States, where Los Angeles is one of the towns making use of such a supply. Generally it is found in oil-bearing districts, and it is quite probable that the presence of the gas at Gruisfontein means that the Rand district is rich in oil as well as in gold and platinum.

Giant Meteors and Meteorites

On the 6th September last people in Yorkshire and adjacent counties were startled late in the evening by what appeared to be a flash and the sound of a big explosion. The matter remained a mystery for a few days, but when the evidence of various observers was collected it was found that a specially brilliant meteor was responsible for the disturbance. The path of the meteor was from the east across Yorkshire toward Derby, where it finally disappeared after a very brilliant flash. Its height when first seen would be about 60 miles, and at the end of its flight of 130 miles it had fallen to a height of 28 miles.

Fireballs, to use a more common term, are fairly similar, but it is not often that we get specimens producing so much noise and light as this one did. In view of its size, it is rather surprising that some of it did not survive the passage through the air, as happened in the case of one that took a similar path and ended in Wigan in 1914. The portion that reached the earth on that occasion weighed 33 lb.

Meteors appear in large numbers in the autumn and it has been found that showers of them can be expected within certain definite date limits. Where they come from is not known with certainty but it is possible that they are the product of disintegration of some heavenly body that has suffered a catastrophe. There is evidence for the belief that they have associations with comets and that they are definite members of the Solar system.

Meteors usually make their appearance at a height of about 75 miles and disappear at a height of about 50 miles. The path always appears to be a straight line, and although the speed may be anything up to 75 miles per second, a meteor is so high up that its flight has the appearance of a slow and stately progress across the sky. The incandescence is due to the intense heat produced by friction between the meteorites and the atmosphere.

The fragments of meteors that reach the earth are called meteorites, and it is very interesting to note that none has been found to contain any elements not already known on the earth. Some very large ones are recorded. One piece that fell at Knyahinya, in Hungary, weighed 645 lb., and with other fragments found near by made up a total of over 1,000 lb. The largest and most famous of all meteorites are three huge ones found by the Arctic explorer, Peary, on the shores of Melville Bay, Greenland, in 1895 and 1897. The biggest of these three weighed no less than 36½ tons! Nobody had seen them fall, and no traditions concerning their origin existed among the Eskimos, but there is little doubt as to their being meteorites. Prizes like these were obviously too good to leave on the bleak shores of Greenland, and they now rest in New York, in the land of big things. The Eskimos may regret this, as they had found one of them a convenient material for making spearheads.

A Rare Photograph

While photographing comet Brooks on 13th November 1893, Professor Barnard was fortunate enough to record the flight of a meteor, which appears as a long straight line on the photograph above. (See col. 1 on this page)

Ocean Abyss Six Miles in Depth

The Japanese survey ship "*Manshu Maru*," working in the Pacific Ocean between the Bonin Islands and Izu, has located a spot at which the ocean bed is approximately 32,636 ft., or about six miles, below sea level. This is the greatest depth of water ever recorded. A crescent-shaped depression has been discovered off the east coast of Japan where the average depth is 24,000 ft., and on the coast side of this depression there is a kind of "ditch" where depths of over 27,000 ft. have already been recorded. The depth of nearly six miles sounded by the "*Manshu Maru*" is in this ditch.

It is interesting to compare this, the greatest depth in the Pacific, with the greatest in the Atlantic Ocean, nearly 4½ miles, at a place in the seas around the West Indies. This latter is an isolated case, however, as scarcely any depth greater than 18,000 ft. is found in the Atlantic. Indeed, in the northern part of this ocean between Great Britain and Newfoundland there is an enormous submarine plateau at a depth of less than 12,000 ft., which seems to have been placed there providentially to assist the layers of submarine cables.

This latest discovery gives the sea a definite lead over the land as far as heights and depths are concerned. Unconquered Everest, the highest mountain known, if dropped into the Pacific Ocean at this point would not reach the surface of the sea in spite of its 29,000 ft., while more than seven Ben Nevis's, or nearly nine Snowdons would have to be piled on top of each other to show above water in the same place.

Life a Mile Below the Sea

The well-known New York zoologist, Dr. William Beebe, is planning another voyage to investigate the depths of the ocean in the tropics. His previous voyage a year ago, in the schooner "*Arcturus*," was devoted to the exploration of the elusive Sargasso Sea, where many good ships were supposed to be hopelessly imprisoned by floating masses of sea-weed. On this voyage the dredges brought up, among other marvels from great depths, fish that gave enough light to enable small type print to be read easily in an otherwise dark room!

For this new expedition Dr. Beebe proposes to build a steel diving tank in which he will descend to a depth of a mile. The tank is being specially made to withstand the pressure of more than a ton to the square inch that it will meet at this depth, and is to be fitted with glass windows so that photographs may be taken. For the safety and comfort of the occupant of the tank a cylinder of liquid air will be supplied, together with suitable chemicals to absorb the carbon dioxide produced by his breathing. Light will not be provided at first as it is anticipated that the luminosity of the fishes themselves at this depth will give all the light necessary. At a later stage a searchlight will be used to facilitate the taking of moving pictures.

If one may judge from the specimens already obtained by dredging, many surprising discoveries are to be expected from Dr. Beebe's expedition. The enormous water pressure and the absence of sunlight a mile below the surface of the water lead to strange variations of form and habit, and freak fishes of many kinds will be seen. One deep-water fish has part of its skeleton outside its body and is bent downward, its tail being higher than its head; while another, known as the "*Blind Ipnops*," has no eyes, but carries a sort of searchlight on the top of its head, possibly for the purpose of attracting the smaller fish on which it feeds.

One of the strangest experiences in the world may fall to Dr. Beebe's lot. This is the sight of what looks like a miniature underwater liner with two rows of brilliantly lighted port-holes—the upper row blue or green, the lower one red or orange, and with special red tail lights at the rear. "*Gonostoma polyphos*" is the imposing name of the particular fish presenting this appearance, and in its natural surroundings it must be well worth seeing, although it is only 10 in. in length.

These creatures can live only in the deep water to which nature has adapted them, and they do not survive the journey in the dredges through the shallower water, so that we only see them as preserved museum specimens with the luminosity gone. Dr. Beebe in his tank will be exploring a practically unknown country. He has, however, a great scientific record, and may be relied upon to produce some exceedingly interesting and valuable results.

Famous Trains and the Routes over which they run

by CECIL. J. ALLEN. M.Inst. T. etc.

A RECORD-BREAKER of no mean order is the "*Cornish Riviera Express*" of the Great Western Railway, for daily it makes the longest non-stop railway run in the whole world! Before the first halt is made, at the North Road Station at Plymouth, this famous "flyer" has bridged the gap between the Thames and the Tamar, travelling westward and southward for 225¾ miles.

Even across the vast spaces of the American continent no actual run can be found of greater length than 183 miles, made by the west-bound "*Twentieth Century Limited*" between Buffalo and Cleveland; while the longest European run, outside our own country, is over the 193 miles between Paris and Brussels.

Thus, by the enterprise of the Great Western Railway, Great Britain takes a handsome lead over the rest of the world in the matter of non-stop train running, just as she does in high-scheduled train-speeds with the 75-minute run over the 77¼ miles from Swindon to Paddington.

Leading Dimensions of G.W.R. 4-6-0 Engines, "Castle" Type

Cylinders (4) Diameter	16 in.
" Stroke	26 in.
Driving Wheels, Diameter	6 ft. 8½ in.
Heating Surface, Tubes ...	...1,886 sq. ft.
" " Firebox	164 "
" " Superheater (14 elements) ...	262 "
" " Total ...	...2,312 "
Firegrate Area	30¼ "
Working Steam Pressure ...	225 lb. per sq. in.
Tractive Effort (at 85% wkg. press.)	31,625 lb.
Water Capacity of Tender ...	4,000 gallons
Coal " "	6 tons
Adhesion Weight of Engine	58¾ "
Total Weight of Engine (in working order)	79¾ "
Total Weight of Engine and Tender (full)	126½ "
Length of Engine and Tender (over buffers)	65 ft. 2 in.

Formation of the "Limited"

A British record is also very nearly established by the weight to which the "*Limited*"—as she is affectionately known all over the Great Western system—is made up at the busier times of the year. In the height of summer this famous train runs in two parts, but in the spring and the autumn the formation is run up to fourteen of the biggest and heaviest 70-foot steel-panelled cars, weighing empty all but 500 tons, and with the full complement of passengers and luggage quite 530 tons behind the engine tender. "Unlimited" would, I think, be a more suitable title than "Limited" for a train of this character!

Like its near neighbour, the 11 a.m. out of Waterloo, the "*Cornish Riviera Express*" is a train of many portions. Next to the engine you find the real "Cornishman," destined to travel as far westward as the iron trail has yet been laid—to Penzance, 305 miles away. This section consists of three coaches and a restaurant car. The St. Ives through coach will keep these company to St. Erth Junction, and the Falmouth coach or coaches as far as the cathedral city of Truro. Then comes the Newquay coach, which parts company with the main train at Plymouth and is taken on from there to the Newquay branch junction, at Par, by a slower train.

But what of the six coaches on the rear of the train? We shall find them labelled successively Torquay (two), Ilfracombe, Minehead and Weymouth (two). How are these to reach their destinations, if the "*Limited*" does not stop before reaching Plymouth? It is obvious that they are not destined to travel to Plymouth and then back again to their various junction stations! No; they are going to be "slipped." The two hindmost will be quietly dropped off at Westbury, 95½ miles from London. Then the Minehead and Ilfracombe coaches will come off together as the "*Limited*" flies through Taunton, 142¾ miles out; and last of all the Torquay coaches will be slipped at Exeter.

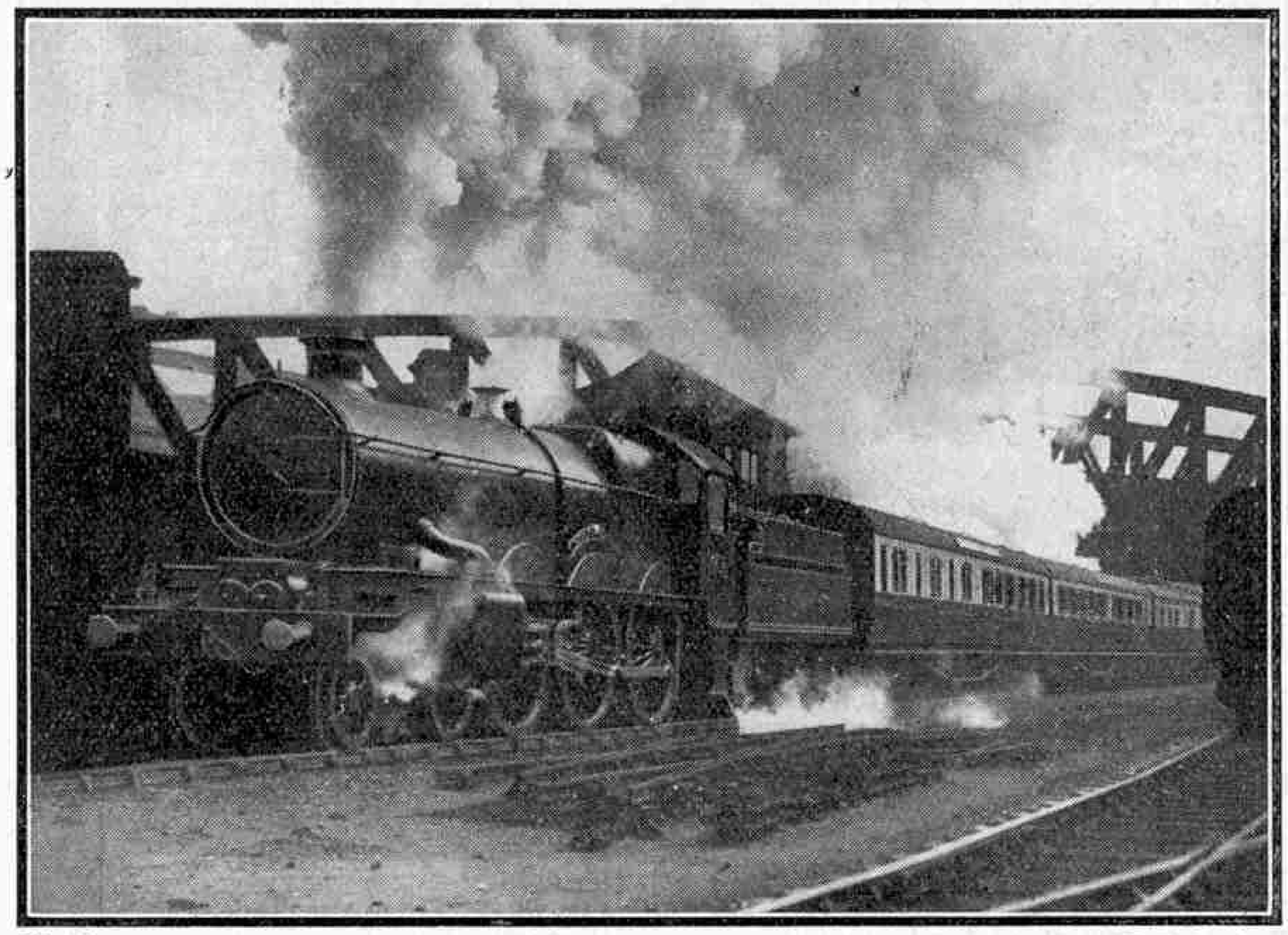
Thus the engine will have been relieved of half-a-dozen of her fourteen coaches ere she draws up at her first stopping-place, and one might quite easily get into the middle of the train at Paddington and, to one's astonishment, find oneself in the last coach on arrival at Plymouth, without having stopped anywhere in between!

"Slip" Coaches

Just a word here about this business of slipping. The advantage, of course, is that it is possible to set down passengers at any intermediate station without the loss of time occasioned by stopping the express for the purpose. But against it, from the railway point of view, are the expense—for each slip portion must have its own guard—and the trouble of providing specially-fitted slip vehicles in the train formation. On the Great Western Railway, to which line with but few exceptions all the slip coaches of to-day are confined, "safety first" is always the main consideration, and in order that no one shall interfere with the slip guard in the performance

of his responsible duties the slip portions are not connected by vestibule with the main train. So one may be travelling as far as Exeter in the "*Limited*" and yet find it impossible to get lunch on the journey, although the restaurant car is only a few coaches away!

The mechanism of slipping is quite simple. At the "business" end of the vehicle is a special form of coupling, by which the slip portion is attached to the main train. At this end also is the compartment in which the slip guard rides, with a good look-out window in front. The hook of the coupling just referred to is hinged in the middle and is held securely in position by means of a sliding bar of steel, which can be withdrawn at the right moment by a lever, worked from inside the guard's compartment. Provision is made, too, for the guard to "seal up the vacuum" in his slip portion. On the main train an appliance is carried that automatically seals the vacuum; otherwise, when the flexible brake-pipe joining the coaches was severed, both halves of the train would come to an unpleasantly sudden stop! In the winter, steam-heat connections are arranged to sever automatically as they are pulled apart, and to seal themselves up in order to prevent escape of steam.



Photo] [*F. E. Mackay*

G.W.R. "Cornish Riviera Express" leaving Paddington, hauled by "Builth Castle"

How the Slipping is Effected

As the train nears the slipping station the guard makes his preparations. First of all he seals up the vacuum of the brake. Then he applies his hand-brake, lightly pressing the wheels of the slip-coach. Finally, at the right place—usually about half a mile from the station, but governed in exact distance by the gradients, the customary speed of the express, and other factors—he pulls over his slipping lever. The wedge is withdrawn, the coupling from the last coach of the main train falls out, brake and steam-heat pipes pull apart and the severance is complete.

The light pressure of the brake soon draws the slip well behind the main train. The hand-brake is then taken off and the slip is allowed to roll into the station, where the guard applies his vacuum brake and brings it to rest. Immediately after slipping he has waved a green flag out of his side window in order that the engine crew may know that the slip is safely "off."

Needless to say, the working of the slips is hedged about with the most careful restrictions, owing to the possible danger of the slip running into the main train after the severance if the latter should be stopped for any reason before it is clear of the station. In fog or thickly falling snow all slipping is suspended, and the express stops instead to detach the slip.

A special horn is fixed to the front of the slip brake, so that the guard may warn any railwaymen, who might be tempted unthinkingly to step on to the line after the passage of the express, that the slip is coming just behind. Special tail-signals, too, are carried by slip portions, consisting of red and white lamps encircled with red and white discs, arranged in various ways. You will find that the innermost, or Exeter slip on the "*Limited*" carries on its back a pair of red and white lamps, side by side. The second or Taunton slip carries the red lamp above the white; while the outermost, or Westbury slip, has an imposing array of three lamps, two red and one white, carried in a triangle. The object of these special indications is to inform signalmen and others that no slip portion has become detached before reaching its rightful destination.

70-ft. Coaches

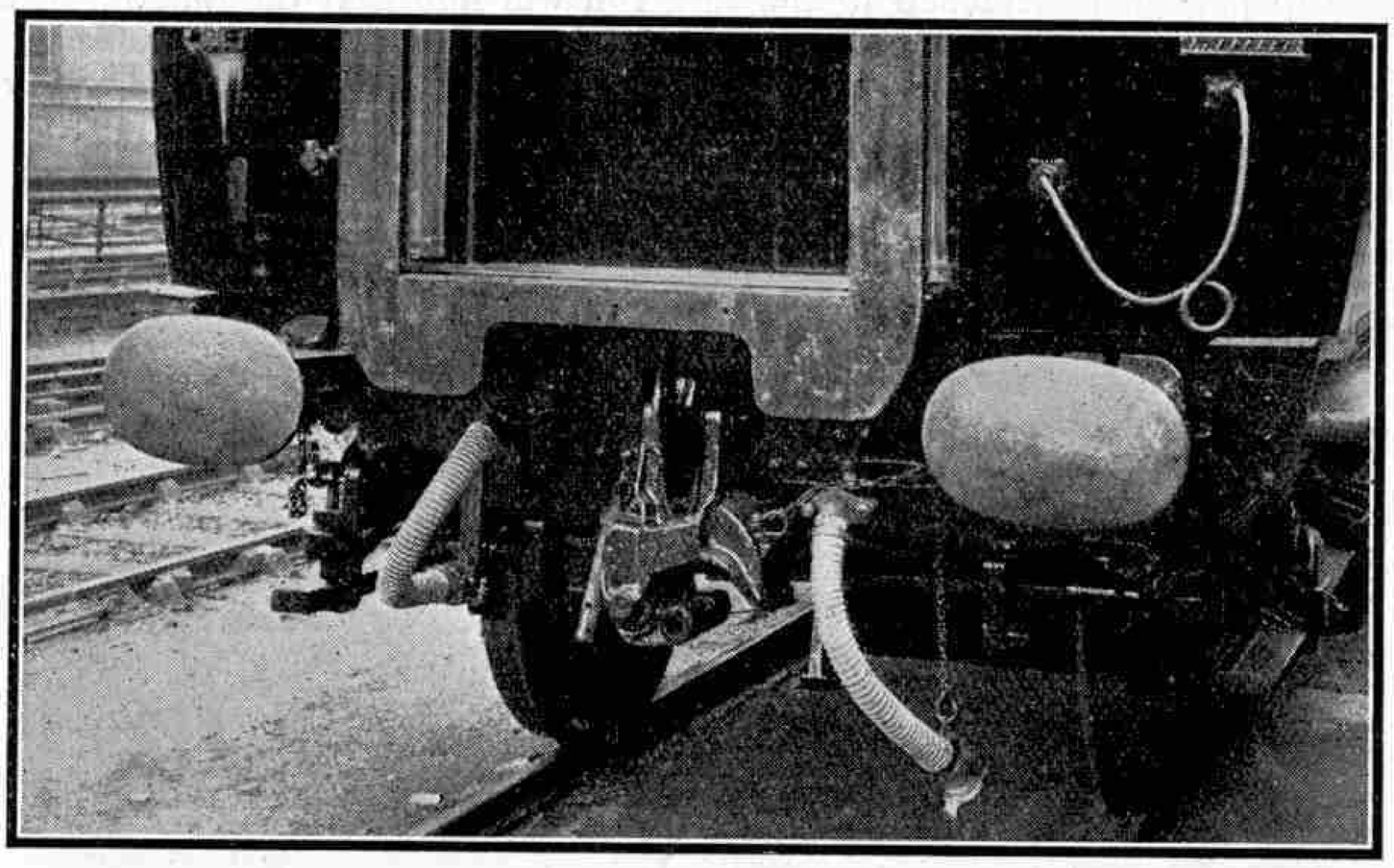
The Great Western Railway use the longest coaches in England. For many years now their standard for long-distance work has been 70 ft., and occasionally as much as 73 ft. 6 in. over buffers. This allows of third-class corridor coaches being made with no less than ten compartments, as well as lavatories at both ends, so that each coach of this type thus seats 80 passengers. Every seat in the "*Limited*," by the way, is numbered, and may be reserved in advance. The latest Great Western coaches, in their handsome chocolate and cream livery, are panelled with thin steel plates, both at the sides and ends and over the roofs as well, steel being found to wear better than wood.

Another recent Great Western innovation has been the use of one combined central coupling and buffer, like two hands coming together in a firm grip, which helps the train to ride more steadily, in addition to being a valuable safeguard against the dreaded "telescoping" of coaches in the unlikely event of a derailment. This is not a new idea, however, having been introduced on the East coast trains of the L.N.E.R. as far back as 1897, and having since become standard on that line. The "*Limited*" is coupled up in this manner except, of course, the slip portions. These newest coaches are tremendously heavy, scaling from 35 to 37 tons apiece.

So, at last, when we have walked up the whole length of this vast train at No. 1 platform at Paddington—the 14 coaches alone measure all but 1,000 ft. in length and the extreme front of the train is probably out of sight round the curve at the outward end of the station—we come to the engine. There is no question as to what type it will be. There is only one class of locomotive on the line capable of keeping time with the "*Limited*," and that is the famous "Castle" class. It is safe to say

that no other type of locomotive in the world has done more wonderful work, in proportion to its weight and size, than the Great Western "Castles." It is not only the haulage of enormous loads at high speeds that is in question here, but the low consumption of fuel and water on which these feats are carried out.

In the exchange of locomotives between the G.W.R. and the L.N.E.R. in 1925 it was proved that, although the L.N.E.R. "Pacific" could work the down "*Cornish Riviera Express*" to time without difficulty, yet the G.W. "Castle," of 12 tons less weight, burned less coal on exactly the same duty. Last year, again, on the L.M.S. line, "*Launceston Castle*" succeeded in gaining time with 500-ton trains, whereas L.M.S. engines are limited to a maximum of 360 tons. Moreover, she did her work on a lower coal consumption per horse-power developed than had ever been recorded previously on L.M.S. metals.



End View of lower portion of G.W. 70 ft. Restaurant Car, showing Automatic Coupler, swung out of position for coupling coach by ordinary screw coupling

"Castle" Class Engines of the G.W.R.

The Great Western "Castle" class engine has the 4–6–0 wheel arrangement and weighs, without tender, 79¾ tons in working order. The latest type of six-wheeled tender, with accommodation for six tons of coal and 4,000 gallons of water, brings the total weight up to 126½ tons. Many reasons have been advanced for the extraordinary capabilities of these Great Western locomotives, but there is little doubt that their success lies largely in the high working pressure that they carry, namely, 225 lb. per sq. in. The force of this pressure, acting on the pistons of the four cylinders, contributes largely to the high tractive power of the engines. The long travel of the piston-valves, which enables their drivers constantly to work the "Castles" in short cut-offs, is probably the chief agent in their efficiency. But this is rather too technical a subject to go into here, and it is now time for us to take our places in the train, as it is just on the starting time of 10.30 a.m.

On the stroke of the half-hour the guard's whistle blows, or the whistle of one of the guards, as four of them are travelling with the train. The driver opens his regulator and we are off!

We have a finer start than exists out of any other London terminus. Other lines have to rise out of the valley of the Thames, but Brunel carried his line westward up the Thames Valley and, by his old route—via Reading, Didcot, Swindon, Bath and Bristol—barely a grade worth mention exists for the whole of the way to Taunton. So by about Southall we attain the mile-a-minute rate, and by Slough we are ticking off the level quarter-miles every thirteen seconds or so, meaning a speed of just under 70 miles an hour. If we are running dead to time we should pass through Reading, 36 miles out of Paddington, in 37 minutes.

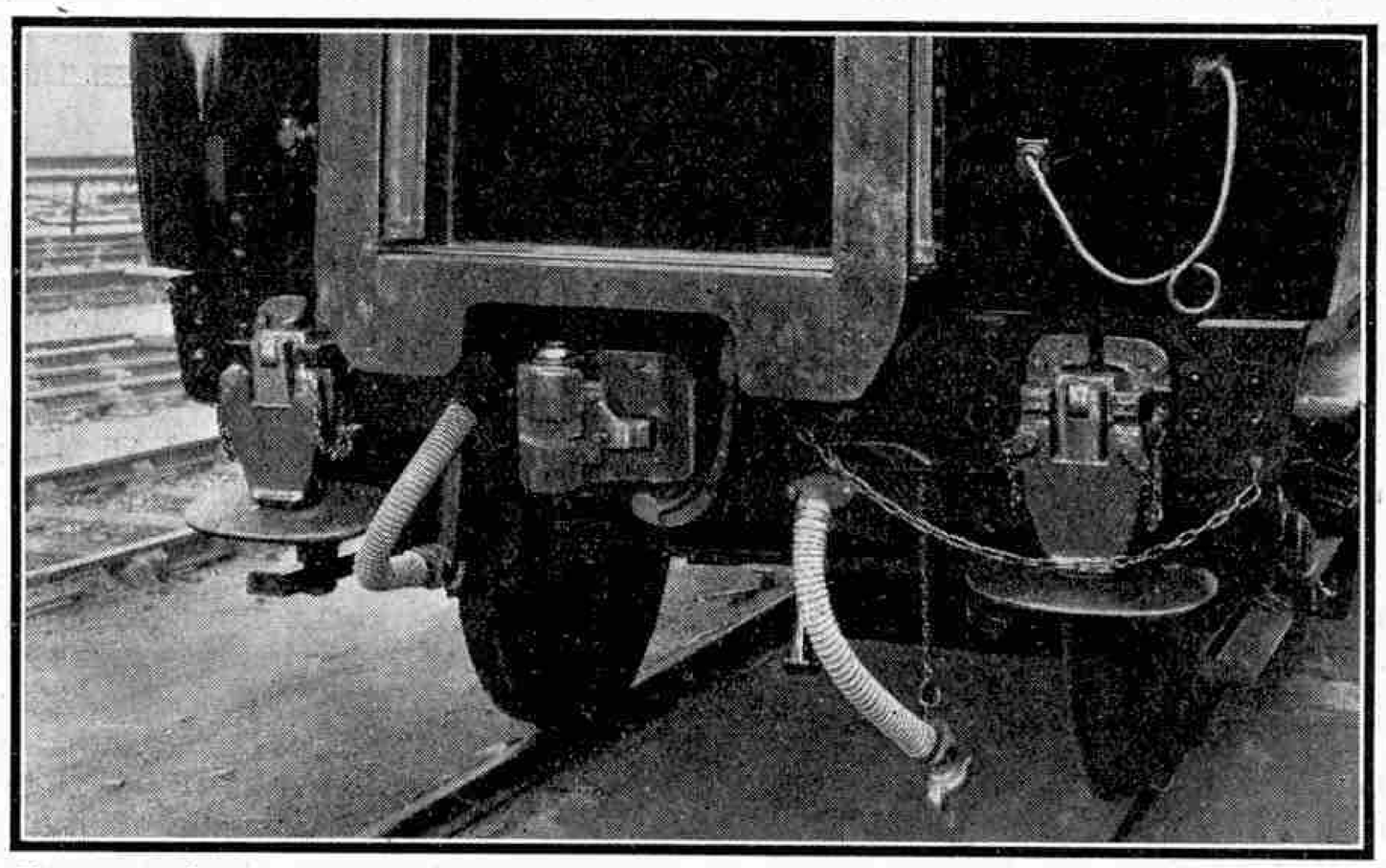
Cutting Off the Corners

Here we must reduce our speed to 40 miles an hour for the curve at the west end of the station, for we are now to leave Brunel's old main line in order to take the more recent short cut by Westbury. After the opening of the 20 miles shorter London and South Western route to Exeter and Plymouth, the old main line by Bristol, beautifully graded though it was, was found too circuitous, and it became imperative to curtail the distance. This was done by bringing the old "Berks and Hants" line up to main line standards, cutting a great corner out of it by linking Patney and Westbury with a new direct route, 15½ miles in length, and then joining Castle Cary, where the Weymouth line bends southward, with the West of England line at Cogload, near Taunton, by another new stretch of line 24½ miles in length.

By this means, costly but effective, the Great Western cut exactly 20 miles from their journey to Taunton and all points west of that town. In the earliest year that the "*Limited*" ran it travelled via Bristol, and so made the even longer non-stop journey of 245¾ miles daily.

The Westbury route is not difficult in its grades, but it has some long stretches of "collar-work" for the engine. Up the valley of the Kennet it gradually rises, past Newbury and Hungerford, steepening then to the summit at Savernake, 70 miles from Paddington. At Aldermaston, 45 miles out of Paddington, occur the first track-troughs, notable by the provision of one of the first water-softening plants erected in England for treating locomotive water. To Savernake we probably shall have taken just about 1¼ hours. Possibly we may be a minute or two behind time, especially if the weather is at all windy, but we may pick up a minute or so on the glorious racing stretch down to Westbury, on which we shall probably touch 80 m.p.h., while descending the 1 in 222 from Patney to Lavington.

A severe brake application heralds the approach to Westbury, owing to the sharp curve into the station, and if we follow the reprehensible practice of leaning out of the carriage window we shall see the two coaches of the outermost "slip" neatly drop off the back of the train. An interesting sight at Westbury, by the way, is the most southerly blast-furnace plant in England, on the north side of the line just beyond the station.



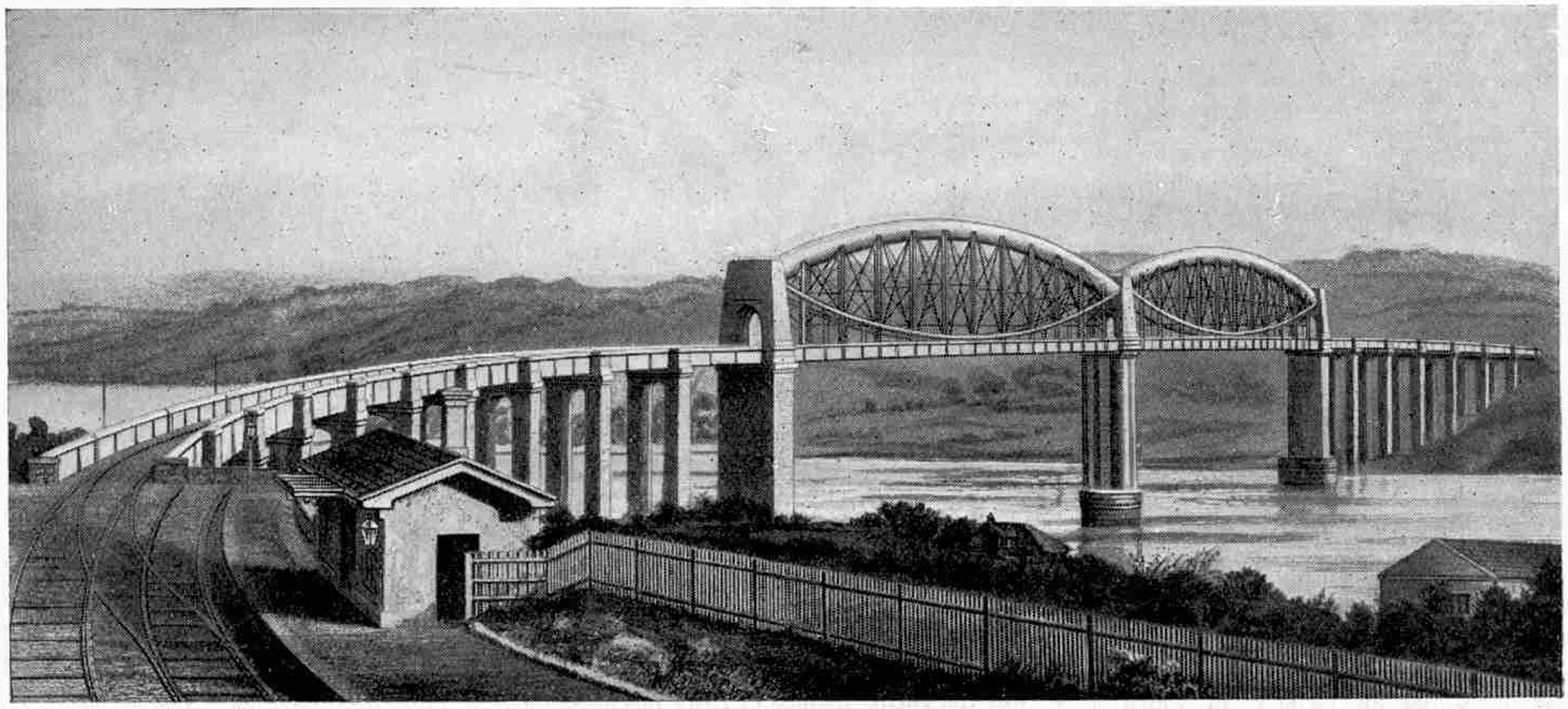
Photos courtesy] [*G.W.R.*

As above, but with Automatic Coupler in position, and side buffers swung out of use

Steepening Gradients

Immediately after Westbury, passed in 97 minutes from Paddington if we have kept time over this initial stretch of 95½ miles, comes another installation of track-troughs, where our thirsty steed takes a second long drink. We have barely recovered from the 30 m.p.h. slack through Westbury when there comes another restriction to the same limit over the Frome curve. From here follow rising grades to the summit known as Brewham or, in the working time-tables, "mile-post 122¾," the actual distance mentioned being the old one by Swindon and Chippenham. The last couple of miles up to this point are as steep in parts as 1 in 107.

Once over Brewham we have in front of us a further high-speed stretch down to Castle Cary, 120 miles from Paddington. The grade

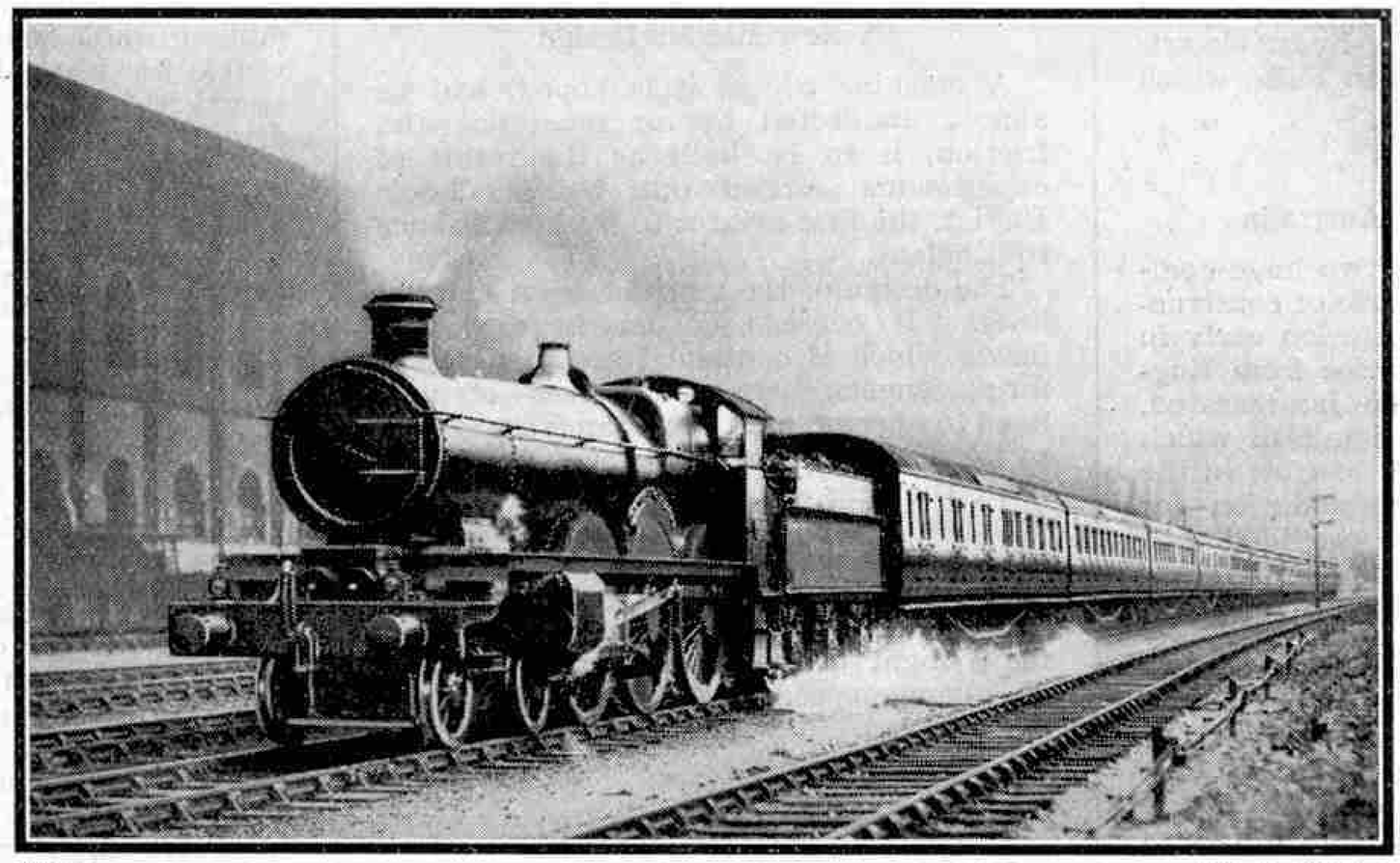


Saltash Bridge, joining Devon with Cornwall

here is mostly 1 in 98, but exceptionally high speeds are rarely run owing to the winding character of the line. Then we pass over the "cut-off" to Cogload and Taunton. From Castle Cary to Taunton is, perhaps, the one easily-timed stretch of the whole journey, and the timing is greatly prized by drivers as giving them a little chance of recovering a few minutes that may have been dropped on the arduous earlier stages. Water is taken from troughs just after the old main line has been joined at Cogload.

Taunton, 142¾ miles from Paddington, should be passed in 148 minutes. Here our steed is thankful to be rid of the burden of two more coaches, as the stiff ascent to Whitehall, where the train crosses the watershed separating the Severn basin from the rivers running southward to the English Channel, is now immediately in prospect. First the ascent steepens during four miles from 1 in 220 to 1 in 163, and then for three miles it increases from the formidable figure of 1 in 90 to 1 in 81. The final three-quarter mile through the summit tunnel is at 1 in 126. With the 530 tons that our "Castle" drew out of Paddington it would not be possible to climb this bank unaided. The load is now four coaches less, however, and with 385 tons our engine finds no difficulty in making the ascent.

Once over Whitehall we have a downhill run of 20 miles to Exeter, which is passed slowly in one minute under three hours from Paddington, our average speed to this point having been no less than 58.2 m.p.h. This, however, is the end of high speed achievement.



Photo] [*F. E. Mackay*

Down "Cornish Riviera," passing Kensal Green, hauled by "Prince George"

Among the "Mountains" of South Devon

The line now has to wind round the coast past Starcross—where we pass over the fourth set of track-troughs—Dawlish and Teignmouth to Newton Abbot whence, as it skirts the southern slopes of Dartmoor and has to cross one by one the deep river valleys finding their way to the sea, it stretches out before our engine the steepest main line gradients in the whole of Great Britain. Fortunately two more coaches were dropped off at Taunton, leaving only eight, of a total weight of 310 tons, which is the maximum that even the powerful locomotives of the "Castle" class are allowed to take unaided over Dainton and Rattery Summits.

The ascent from beyond Newton Abbot to Dainton Tunnel is only two miles long, but its steepest pitch is no less severe than 1 in 36, and if we top the summit at anything much over 20 m.p.h. we shall do well. Then follows an almost equally precipitate and very sharply winding descent to the valley of the Dart at Totnes, whence we are faced with Rattery Bank, five miles long, 2½ of which are at 1 in 51 or but slightly less steep, and another 1½ at 1 in 90. From Rattery we go away over a "tableland" past Brent and Ivybridge, finishing with another terrific drop, for two miles at 1 in 42, from Hemerdon Box down to Plympton. This is the terror of drivers in the reverse direction, coming so soon after the Plymouth start, with no chance of taking a "rush" at it.

So, probably on the stroke of 2.37 p.m., our "Castle" brings the "*Limited*"—or what is left of it!—to rest at North Road Station at Plymouth. Even after so strenuous a task as this, however, her day is not done, for, in charge of another crew, she has yet to retrace her tracks over that last formidable stretch of line, by making a trip from Plymouth to Exeter and back before nightfall.

On to the seven coaches of the "*Limited*"—the Newquay coach is to follow—another engine has now been hitched. Until recently the handy "Moguls" were responsible for most of the Cornish work, but 4–6–0 engines, even up to and including "Castles," now work freely right through to Penzance, and quite likely we shall have a four-cylinder 4–6–0 "Star" for the rest of the journey. The ups-and-downs of the Cornish main line are so terribly steep and the curves so sharp that we must not expect much in the way of speed. To Truro, our next stop, 80 minutes are allowed for the 53¾ miles.

Saltash Bridge

Chief interest in this part of the run centres in the crossing of Brunel's magnificent Saltash Bridge, which takes us over the Tamar from Devon into Cornwall, four miles after leaving North Road. The river here is 1,100 ft. wide, and the difficulty of spanning the waterway was the greater in that its depth in the centre was some 80 ft. This difficulty Brunel overcame by the use of caisson construction, and he managed to "fly" (*Continued on page* 183)

Air News

Prospecting by Aeroplanes

In countries containing many huge unmapped areas the aeroplane is rapidly proving its worth as a means of opening-up country that hitherto has remained almost inaccessible. In Canada especially is the aeroplane being employed and recently we recounted an incident in which a machine was used by prospectors taking part in a gold rush. Another case recently reported from Canada concerns an amphibian flying boat that has just returned from High River after completing a journey of from 6,000 to 7,000 miles in the North-West territories. The machine carried a party of three engineers who were prospecting for minerals and they have expressed themselves as highly satisfied with the mode of transport.

In a further instance an aeroplane was used to make a photographic survey of the region surrounding the great falls on the McLean River in the Ungava district of the province of Quebec. This work was carried out for the Ministry of Lands and Forests, which is considering a proposal for the establishment of a hydro-electric power station at the McLean Falls, which have a sheer drop of 312 feet.

* * * *

Airship Service to Australia

It is hoped to place the two huge commercial airships now in course of construction in this country in operation early in 1928, when the airship service from England to Australia will be inaugurated. Each of these big airships, details of which have been given from time to time in the "*M.M.*," will have accommodation for 100 passengers, and will be provided with sleeping berths, dining, lounge and smoke rooms.

* * * *

First Seaplane for Khartum—Kisumu Route

The launch of the first seaplane that is to be used in the recently-organised East African air-line was performed by Lady Beatrice Ormsby-Gore at the works of Messrs. Short Bros. at Rochester.

The machine is to be known as "*The Pelican*" and is a four-seater D.H.50, fitted with a 420 h.p. Radial Bristol Jupiter engine and a Fairey-Reid metal airscrew. The duralumin floats have been made by Short Bros. The unique combination of British firms in the construction of this machine is worthy of special notice.

The new air-line is to be operated by the North Sea Aerial Transport Company, which has entered into a service agreement with the Governments of Kenya, Uganda and the Sudan.

The Paris Aero Show

One of the most important aero events of the year 1926 was the Aero Show held in the Grand Palais in Paris in December. Practically every important manufacture of aeroplanes and aeroplane engines was represented. A notable feature of the show was the entire absence of freak machines, and only in one or two cases were the machines of what might be termed an unknown quantity. Another point of interest was the considerable increase in the number of firms using metal, and especially duralumin, in the construction of their machines.

Air Ministry regulations preclude the publication of performance details of British aircraft, and therefore it is not possible to give a comparison between British and foreign machines. It may be said, however, without fear of contradiction, that, from an all-round standpoint, British machines as a class, are vastly superior to their competitors.

* * * *

A New Bleriot Design

A machine which, it is hoped, will be almost unaffected by air resistance and friction, is to be built as the result of experiments carried out by M. Louis Bleriot, the first aviator to fly from France to England.

The design of the machine is on unusual lines. It consists of one huge wing—inside which is contained accommodation for passengers, cargo, and engines—streamlined to offer as small a resistance as possible to the air. The control surface will project from the rear of this wing, the internal dimensions of which may be gauged from the fact that the saloon will be more than six ft. in height. The machine is intended for trans-oceanic travel and will carry petrol for a flight of many thousands of miles. An average speed of more than 120 m.p.h. is projected.

* * * *

The Luft Hansa Air Services

With reference to our recent note upon Germany's endeavours to obtain complete mastery of the European air-routes, the activities of the Luft Hansa Co., which in Germany occupies a similar position to that held by Imperial Airways in England, are of interest.

The Luft Hansa is a combination of most of the old private air companies, such as the Junkers and Aero Lloyd, and its network of routes covers the whole of Germany. Its service is most efficiently organised and has a remarkable record of freedom from accidents, while maintaining a strict time schedule. This record of safety is the principal cause of the popularity of commercial flying in Germany.

The chief long-distance routes operated by the Luft Hansa are from Berlin to Copenhagen; Berlin to Amsterdam and London; Cologne to Brussels and Paris, Vienna and Budapest. It is intended this summer to open up a route from Munich to Milan. This route will lie across the Alps and Rohrbach triple-engined machines will be used. It is anticipated that the average altitude at which the machines will fly will be approximately 12,000 ft. thus avoiding cloud-banks and securing perfect visibility throughout.

* * * *

Aerial Lighthouse on Mt. Etna

The Italian Government propose to erect a great lighthouse on the summit of Mount Etna, 10,813 ft. above sea level, to serve as a guide for airmen engaged in night flying. It is understood that the combined power of the electric lamps installed will be greater than one thousand million candle power and the light will be visible for many hundreds of miles. The electricity will be produced by a windmill-driven dynamo.

A lighthouse of similar power recently brought into use by the French authorities is situated on Mont Valerien, and until the Italian light is completed will be the most powerful lighthouse in the world. This is the second French aerial lighthouse, the earlier one being that on Mont Sait Affrique, near Dijon, possessing a light of 800,000 candle power.

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Swiss Flight to Africa

An aero scientific expedition has set out from Switzerland en route for Africa with the object of studying animal life and geological formations. The trip will probably last about three months and the route will be via Cairo, the Nile Valley, Kenya Colony, the Belgian Congo, thence down the Zambesi to Abain and from there to Portacal, Port Elizabeth and Cape Town. The machine is a 450 h.p. Mercury seaplane and is being piloted by Lieut. Mittel Holzer.

* * * *

Canadian Air Mails

An air mail service is to be opened shortly between Sioux Lookout and the gold camps at Woman Lake and Birch Lake, Ontario. A similar service is already in existence between the Red Lake camp and Hudson and thus Ontario's three newest goldfields are equipped with the most modern type of mail service.

Passenger Bombs !

Aeronautics seems to be a peculiarly fruitful field for the planting of freak suggestions. The latest proposal, stated to have emanated from a French scientist, is, we think, unlikely to meet with enthusiastic support from air travellers, for whose benefit it was made.

The idea is that a passenger-carrying aeroplane should be so fitted that by releasing a lever the pilot can turn the machine over, flinging out his passengers, who are each attached to a parachute. The intention underlying the suggestion obviously is to secure a safe landing in the event of a mishap to the machine. It would have to be a very serious mishap, however, to reconcile us to the idea of being dumped overboard like a sack of potatoes.

* * *

Spanish-American Air Convention

The refusal of Spain to co-operate with the Geneva Air Navigation Conference has now been explained by the setting up of a Spanish-American Air Navigation Convention, the main outlines of which were agreed upon recently by Spanish and South American delegates who met at Madrid.

For some time past it has obviously been the aim of the Spanish aircraft industry, backed by German interests, to secure a complete monopoly of the airservices from Europe into Central and South America. The South American delegates objected to the ultra-protectionist policy of the Spanish Government, however, and declined to agree to the creation of a monopoly that would debar their States from negotiating with other countries. None the less, sufficient progress was made to enable Spain to embark upon its programme and the construction of airships and seaplanes for the service will shortly be commenced.

The project is to develop the Spanish aircraft industry to an extent that will place the country in the forefront of aviation powers, and the Spanish State Council have formally confirmed a contract, entered into between the Government and the Spanish-German Constructing Company, under which a subsidy of half a million pesetas (£20,000) will be granted in respect of the first trans-Atlantic flight made by each of the new airships and seaplanes within the next three years.

* * * *

The first South African flying club has been formed at Johannesburg and will be known as the Johannesburg Light Aeroplane Club.

Cherbourg-Southampton Air Service

Negotiations are proceeding between the French and the British Governments for the establishment of a regular flying boat service between Cherbourg and Southampton. By landing passengers and mail at Cherbourg and allowing them to proceed to Southampton by flying boat, approximately one day on the trans-Atlantic journey would be saved. It is proposed to operate a return service.

Over the Alps in a "Cherub" !

A wonderful photograph of the Alps, taken at a height of 15,000 ft. during the flight from Munich to Rome, which flight was described in the "M.M." last month

An Air Ensign

An official air flag to be flown by all British commercial air machines is shortly to be introduced. Imperial Airways are at present carrying out experiments to discover the most suitable materials for use —not an easy task when it is remembered that the flag will have to withstand the buffeting of air streams whipping past at speeds up to 120 m.p.h.

* * * *

French Air Line to South America

The proposed French air line between Daker in West Africa and Pernambuco in South America may possibly be in operation by July of this year. The service is to be run by the Latecoere Company, which already operates the route from France to Dakar. It is proposed to use flying boats from Dakar to the Cape Verde Islands and from the Island of Noronha to Pernambuco, the long sea section between Cape Verde and Noronha being operated by fast steamships.

Hyde Park Aerodrome

The establishment of an aerodrome in Hyde Park for the use of owner pilots and private air-taxi companies is a proposal that has been put forward recently and has evoked considerable controversy.

The re-arrangement of a few railings and the cutting down of a small number of trees are the only necessary alterations to the suggested site, and while one is very loth to advocate the adoption of any scheme that involves the spoliation of this beautiful area of parkland, one cannot overlook the fact that one of the principal hindrances to private flying is the lack of aerodromes within convenient reach of our great cities. In many instances journeys of considerable length have to be made before the nearest aerodrome is reached and the margin of time gained by the use of an aeroplane is thus considerably reduced. Private flying can make no real progress while conditions such as those exist.

The argument that the only available spaces within the cities are the public parks and, as such, spaces reserved to the free unfettered use of the public, is not so strong as might appear. The public are keenly interested in aviation and it is highly probable that the "man in the street" will welcome an innovation that promises a closer knowledge and acquaintanceship with the most modern form of transport, provided that due regard is had to safety.

* * * *

Policing the Air

The first organised aerial police squad has been formed in Los Angeles, California, five members of the Aero Corporation of California being sworn in as regular members of the police force. Recently two aeroplanes have been stolen from private aerodromes in different parts of the United States, so it would appear that an aerial police organisation may shortly become a necessity.

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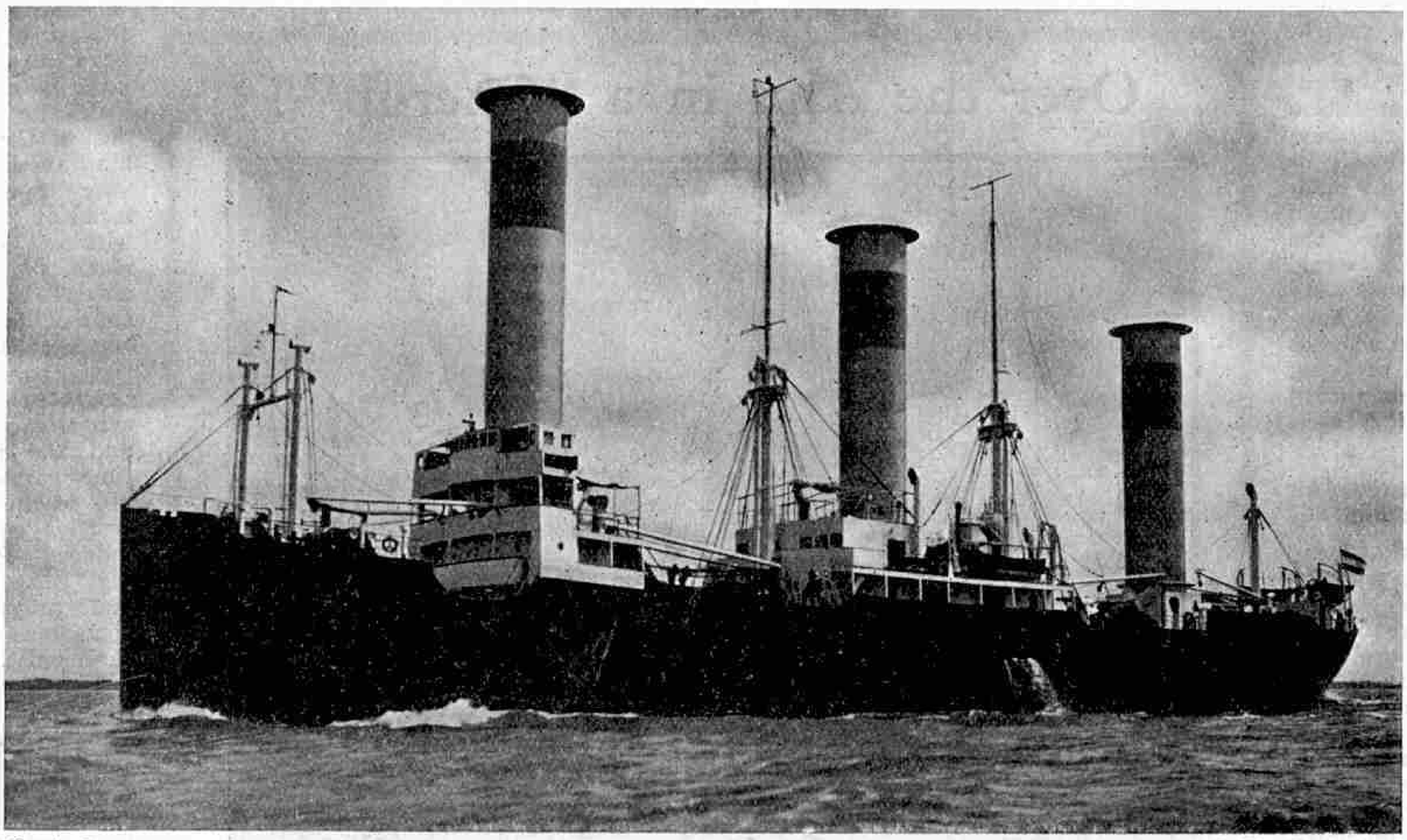
Anglo-Italian Service to Egypt

A representative of the Italian Light Air Transport Co. was recently in England to discuss with the Air Ministry and Imperial Airways the project for extending the present London-Zurich service to Egypt, via Italy and Greece. If the proposed service is introduced it will constitute the Western link with London of the recently organised Cairo-Karachi route.

The Rotor Ship "*Barbara*"

Success of First Trials



Courtesy] ["*The Shipbuilder*"

The Rotor Ship "*Barbara*"

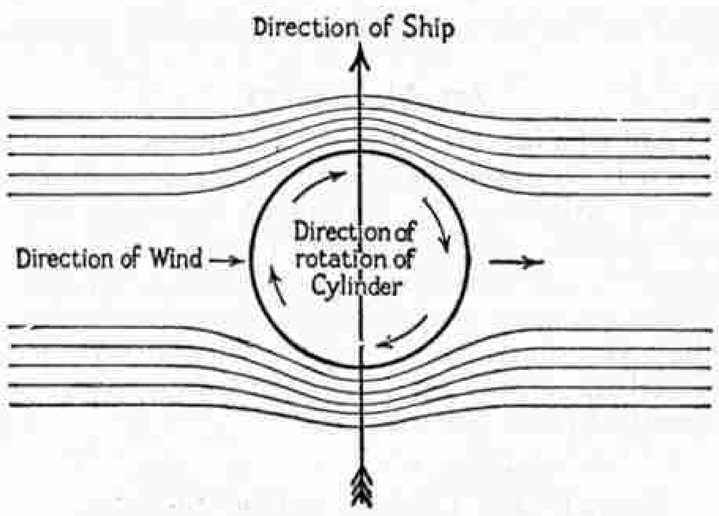
IN the "*M.M.*" for January, 1925, we gave a description of a remarkable vessel named the "*Buckau*," better known as the Flettner Rotor Ship. In this vessel a discovery made over 70 years ago by Professor Magnus, a German, was utilised in an interesting manner by another German, Anton Flettner. The discovery made by Professor Magnus was that the propelling power of wind acting against rapidly rotating cylinders was much greater than the power of the same wind when acting against a stationary surface such as a sail.

The rotor principle for ship propulsion has been brought into considerable prominence recently as the result of the successful trials of the "*Barbara*." Before describing this vessel, however, we will give a brief description of the method of propulsion involved.

Principle of Rotor Propulsion

In the Flettner rotor ship the propelling force is derived from the wind just as in the case of an ordinary sailing vessel, but in a different manner.

When both the vertical cylinders or rotors are rotating in the same direction they tend to propel the ship in a direction practically at right angles to that of the wind. A little study of the accompanying diagram will make this clear. If the directions of the various arrows are examined it will be seen that, on reaching the cylinder, the air current divides itself into two streams in order to pass round the obstruction. The cylinder is rotating in the direction indicated. The air stream on one side therefore meets a surface moving in the same direction as itself and this has the effect of accelerating the flow of air, thus producing suction tending to draw the ship forward in the direction of the large arrow. The air stream on the other side encounters a surface moving in the opposite direction to itself and its flow is retarded, thus causing pressure tending to push the ship forward.



The rotor ship is really an application of the forces that are at work when a tennis ball, to which spin has been imparted, deviates from the straight path. The same principle explains also the "drift" of projectiles fired from rifled guns and the remarkable effects produced by a "googlie" bowler.

The Original Rotor Ship

The "*Buckau*" was not designed for rotor propulsion, but was originally a three-masted sailing vessel with auxiliary engines. She was adapted for the purpose by Flettner, who installed two rotor towers in place of the masts. The towers were 50 ft. in height and 10 ft. in diameter and, extending to the bottom of the ship, revolved on pivots. Each tower was driven by a small motor of about 9 h.p. and had a maximum rotary velocity of 120 revs. per minute. Steering was effected by varying the rotation of the towers, no rudder being used. Dials indicating

the speed of rotation of each tower were installed on the bridge and, by means of a control handle, the helmsman was able to vary the speed and direction of that rotation, thus directly manœuvring the ship.

This vessel was moderately successful but, as she was not specially designed for rotor propulsion, the results were not conclusive. The "*Barbara*" was specially designed and constructed for rotor propulsion and was built at the instigation of the German naval authorities. She was operated in comparison with two motor vessels, the "*Sorrento*" and the "*Amalfi*," designed on the same structural plan and built on the same scale.

Details of the "Barbara"

The "*Barbara*" is purely a freighter and has a capacity of 2,785 tons. She is 293 ft. in overall length, 43 ft. in beam, and, when loaded to the Plimsoll line for summer, draws 17½ ft. of water.

The three rotor towers are 13 ft. 1½ in. in diameter and 55 ft. 9 in. in height. Their construction has been very carefully designed to combine lightness with strength, the importance of the latter being immediately obvious when the stresses that will occur in them owing to the motion of the ship in heavy seas are remembered.

It is interesting to note that one of the methods adopted to secure the necessary combination is the use of the light aluminium alloy "Lautal" for the shell, which is supported on the inside by girders. As explained on p. 447 of "*Our Wonderful World*" in the July number of the "*M.M.*," this alloy of aluminium with a small percentage of copper, iron, and silica, possesses great strength, and also has the advantage that it is very resistant to the corroding effects of sea-water.

Six-cylinder Diesel Engine Equipment

At the foot of each rotor tower is a 41 h.p. motor, driven from the electric generating plant of the ship. These are connected through reducing gear to the driving shafts of the rotors, a maximum speed of 160 revolutions per minute being attainable. The application of this power to the rotors is controlled electrically from the bridge of the ship.

In addition to the rotor towers constituting her main feature, the "*Barbara*" has two sets of six-cylinder Diesel engines. These oil engines develop between them 1,060 brake h.p., and can be used either separately or together to operate the single propeller. In general the speed of the ship is nine knots when the propeller is driven by the two engines together.

Rotors Compared with Propellers

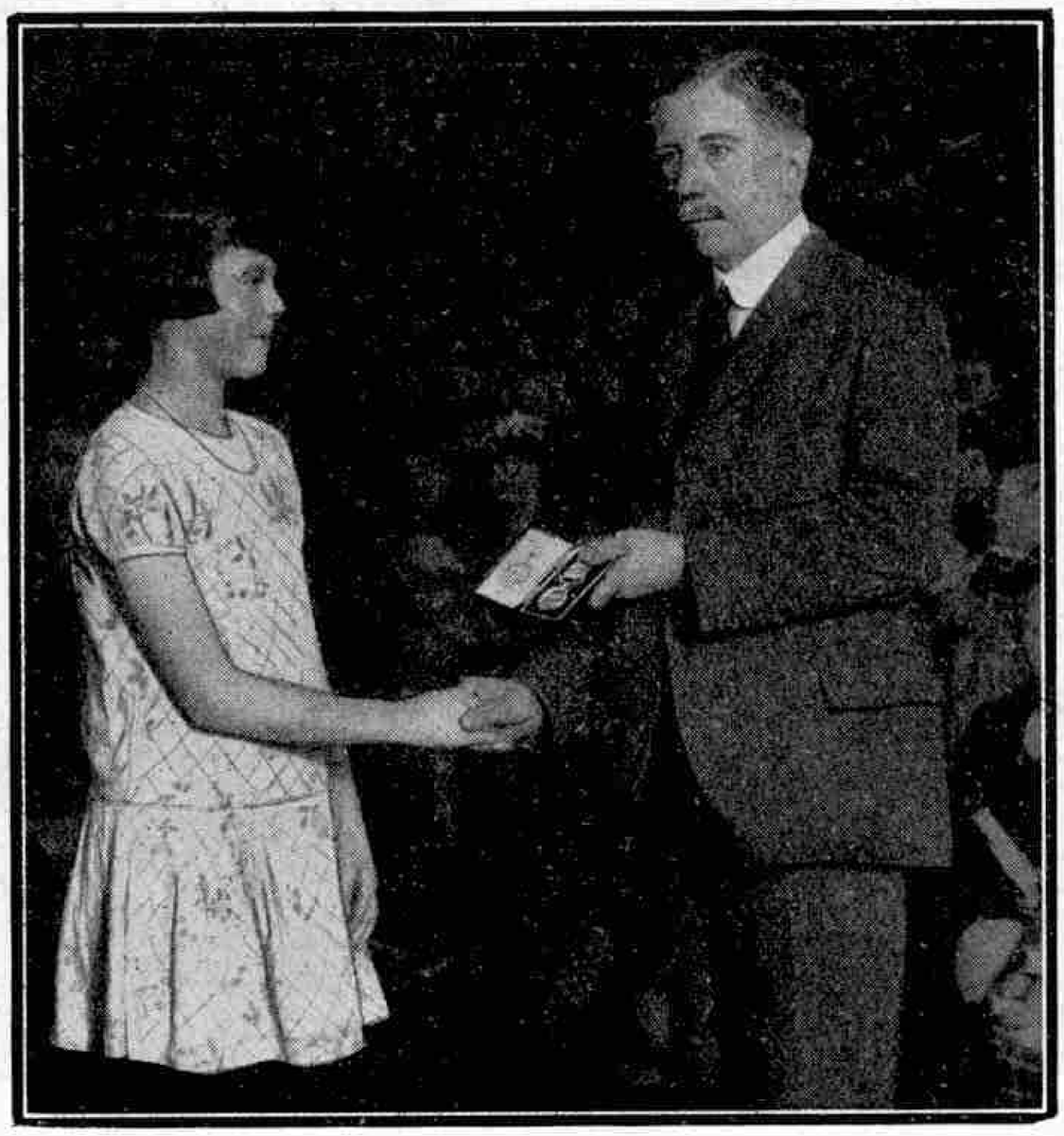
The effect of the rotors at varying wind powers was tested by careful comparison with the work of the oil engines. As an example of the results obtained, the speed at wind powers 4 and 7 may be given. Numbers are used by meteorologists to denote the strength of the wind, and on the scale adopted, known as the Beaufort scale after the famous meteorologist who devised it, the number 4 indicates a moderate wind, while 7 is the number used for a much stronger wind, such as is usually described as a moderate gale.

At the former wind power, the screw operated by both engines drove the ship at nine knots, and when one engine was cut out and use made of the rotors the speed increased slightly to 9½ knots. This indicates that in a moderate wind the rotors of the "*Barbara*" were roughly equivalent to one 500 h.p. engine, and this horse-power from the wind was made available by the use of the power required to drive the rotors only, estimated at about 100 h.p.

At greater wind powers the rotors were even more effective, and with a wind of power 7 the ship was capable of a speed of nine knots with the rotors alone; in other words, the rotors were just as effective as were the two Diesel engines operating on the screw.

Thus, by taking advantage of the wind, the "*Barbara*" was very often enabled to reduce her oil consumption to one half or even less without any reduction in speed, and these preliminary results appear to indicate a very important future for this new method. This is not the first time, of course, that attempts have been made to combine wind power and engine power for ships, for early steamships, even down to the time of the "*Great Eastern*," retained the use of sails. It is quite easy to see, however, that Flettner's return to the dual method possesses many advantages over the old plan.

Girl's Brave Deed



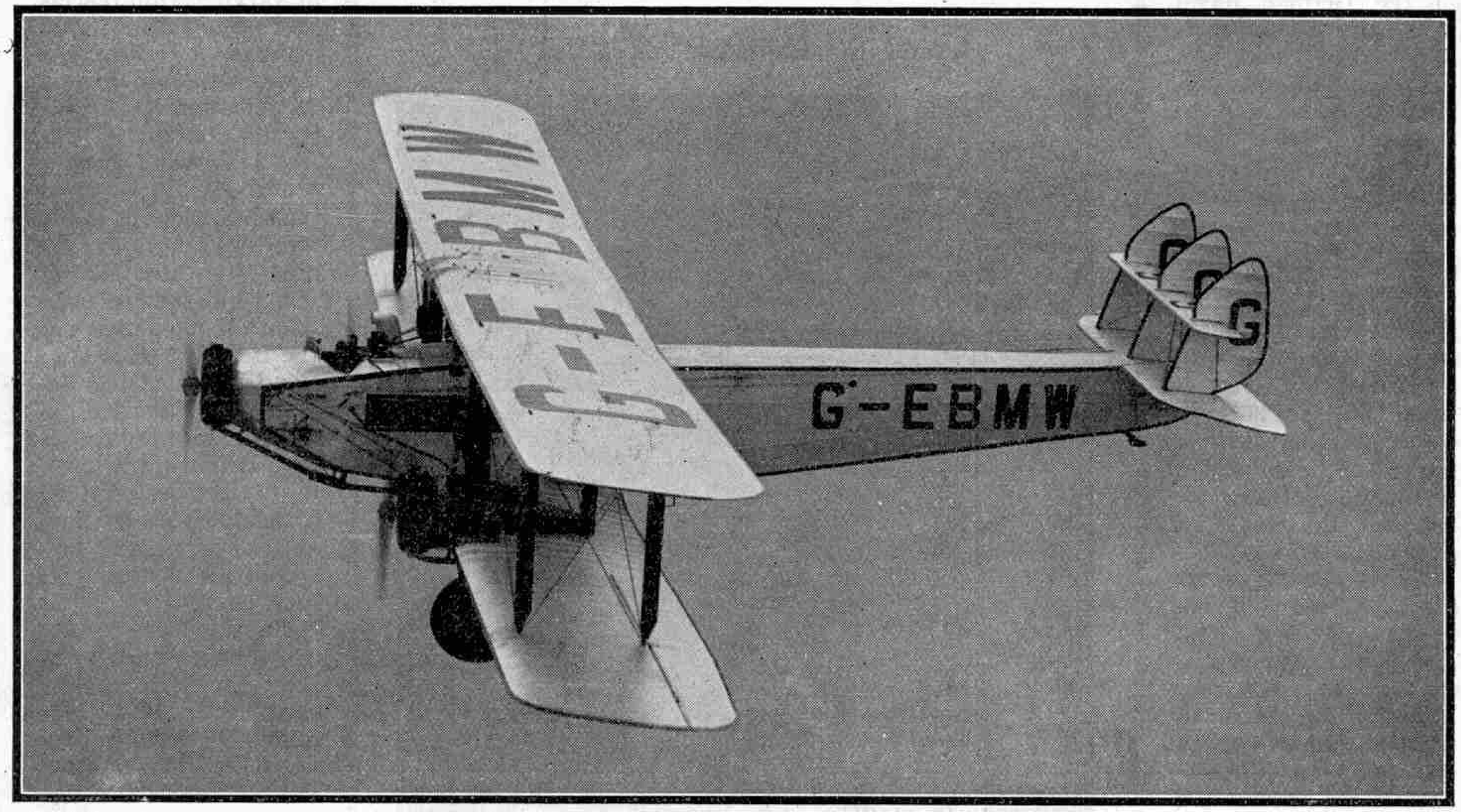
Our photograph shows Miss Dorothy McLellan, aged 14, being presented with the medal of the Liverpool Shipwreck and Humane Society for a gallant rescue in the River Mersey. Miss McLellan was at the time employed in the Packing Department of Meccano Limited, but is now engaged in the Magazine Department.

On 22nd July 1926, Miss McLellan and her sister were paddling in the water at one side of the slipway at Egremont. Suddenly there was a commotion and a cry from the other side of the slipway and on running across Miss McLellan found that a child of about eight years of age had fallen into the river, and was in danger of being carried away by the strong current and drowned. Miss McLellan plunged into the river without hesitation, swam out some twenty yards, caught the child and brought her safely ashore.

In addition to the above-mentioned medal Miss McLellan has been presented with a special medal "For Gallantry" from the Liverpool and District Teachers' Association.

Saving Sixteen Days!

The "Hercules" Opens First Empire Air Service



Courtesy] **A fine photograph of a D.H.66 "Hercules" in flight** [*The de Havilland Aircraft Co. Ltd.*

OUR readers will remember that last year we held a competition in connection with the naming of the new D.H. 66 aeroplanes, and that the prize-winners were awarded flights in a "Moth" aeroplane at Stag Lane Aerodrome. In this competition our readers were invited to submit their suggestions for a type-name for these new air-liners that were to be used on the Egypt-India air route. As a result of the voting the de Havilland Aircraft Co. Ltd., chose the name "Hercules" to be applied to the D.H.66's, which at the time were in the course of construction. Since then some of the air-liners have been completed and we think our readers will be glad of some further information in regard to the machines in the naming of which they were so closely concerned.

Five "Hercules" have already been built by the de Havilland Co., to the order of Imperial Airways Ltd., and these giant air-liners will be used on the new passenger, mail, and goods service between Cairo, Baghdad, and Karachi.

The testing of the first of these machines, G–EBMW illustrated on this page, was recognised as a great day.

After final adjustments had been made, the three Jupiter engines were run up and the whole machine was thoroughly examined by the Air Ministry Inspection Staff. Captain H. S. Broad, who piloted several "*M.M.*" readers in their prize-winning flights, then entered the cockpit through the small door leading from the cabin to the pilot's "office." After the machine had taxied out into a suitable position for taking off, the engines were opened out and the "Hercules" left the ground after a run of only a few yards. A great cheer went up from the crowd, which included 800 employees of the de Havilland Co., whose interest in the new machine was such that they were all present to see its first flight. This action is in keeping with the general interest of the employees of this firm in all "D.H." products.

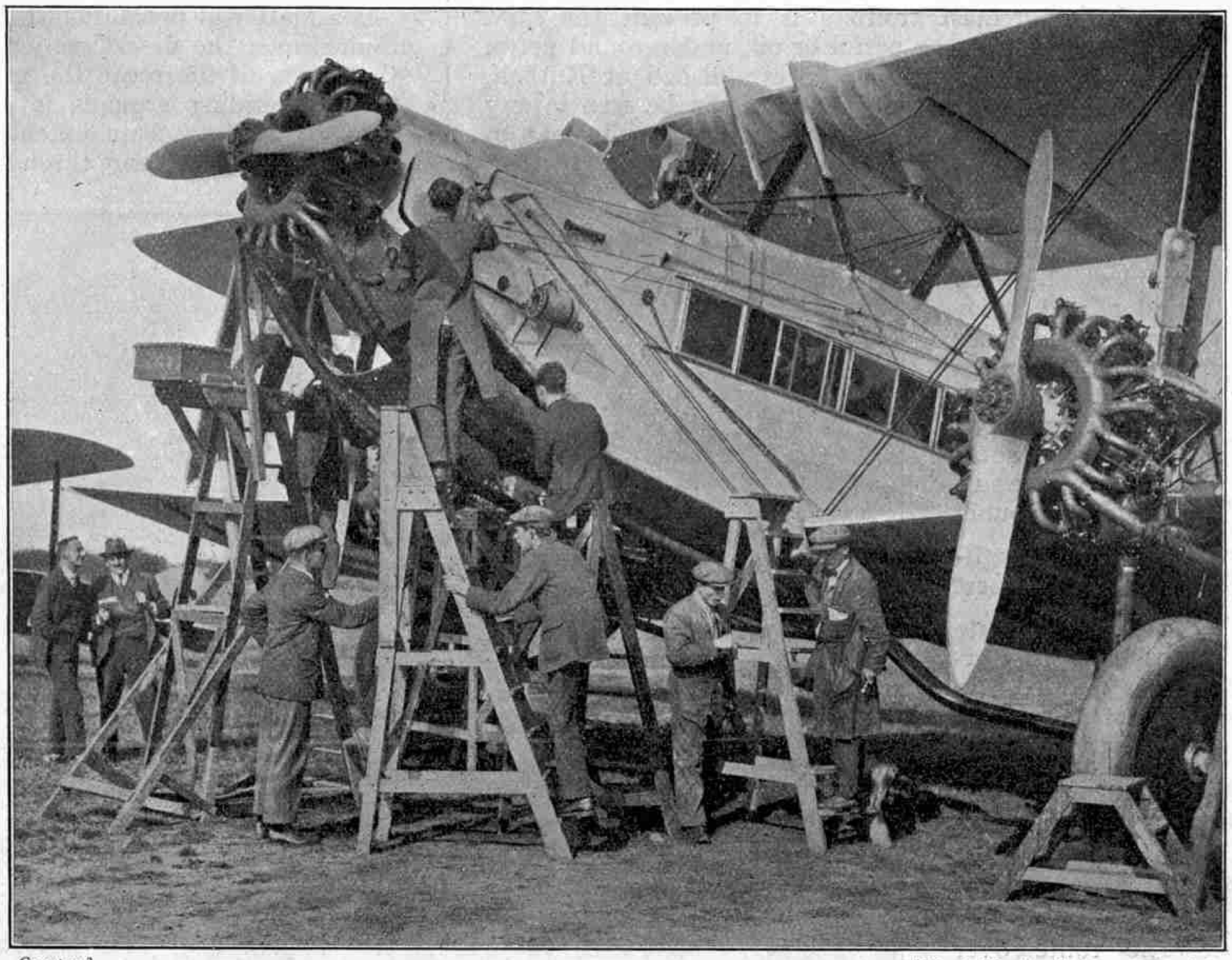
TIME-TABLE (Eastbound)

Wed.	Cairo	dep.	1.00 p.m.	Fri.	Basra	dep.	5.00 a.m.
,,	Gaza	arr.	4.00 ,,	,,	Bushire	arr.	9.15 ,,
Thurs.	,,	dep.	6.00 a.m.	,,	,,	dep.	10.15 ,,
,,	Rutbah	arr.	10.15 ,,	,,	Bundar Abbas	arr.	3.45 p.m.
,,	,,	dep.	11.15 ,,	Sat.	,,	dep.	6.00 a.m.
,,	Baghdad	arr.	2.10 p.m.	,,	Charbar	arr.	10.15 ,,
,,	,,	dep.	2.30 ,,	,,	,,	dep.	11.15 ,,
,,	Basra	arr.	5.35 ,,	,,	Karachi	arr.	4.45 p.m.

Captain Broad then flew on various combinations of engines and circled the aerodrome with both right and left hand turns. After about fifteen minutes' flight, a faultless landing was made and the machine taxied back to the hangars amid renewed cheering.

Full constructional details of the "Hercules" have already appeared in these pages. Three Bristol 450 h.p. Jupiter engines are fitted—and this reminds us that the choice of the name "Hercules" was very appropriate,

in more senses than one! Incidentally, it may be mentioned that the exhaust manifold of each engine costs as much as a complete Austin-seven motor-car!



Courtesy] [*The de Havilland Aircraft Co. Ltd.*

A "close-up" of the nose of the "Hercules." Behind the machine are Mr. A. H. Morse, Chief Inspector of the de Havilland Co., and Mr. H. Povey, of the Drawing Office

Carries Petrol for 525 Mile Flight

The engine power is such as to be ample to overcome loss, due to climatic conditions. In explanation of this it may be mentioned that the route passes over the Jordian Hills, which rise to a height of 3,500 ft., whilst the Arabian Desert is about 2,900 ft. above sea-level. Here the temperature may be anything up to 123° in the shade, in which high temperature an engine that will give 482 h.p. in England will develop only 427 h.p. at the same revolutions, owing to the low weight of air taken into the cylinders on each suction stroke.

The machine climbs at the rate of 765 ft. per minute (at ground level). As the cruising speed is 110 m.p.h. and top speed 130 m.p.h., there should be no difficulty in combating the strong head winds that inevitably will be encountered over the desert air-routes.

The minimum amount of power necessary to fly level with a full load is only about 275 h.p., so that the "Hercules" can take off, fly and even climb with any two engines. With only one engine running the machine loses height very slowly. For instance, assuming that any two of the engines should fail at an altitude of 4,000 ft., it could reach a landing place anywhere within a radius of 30 miles, working on one engine alone.

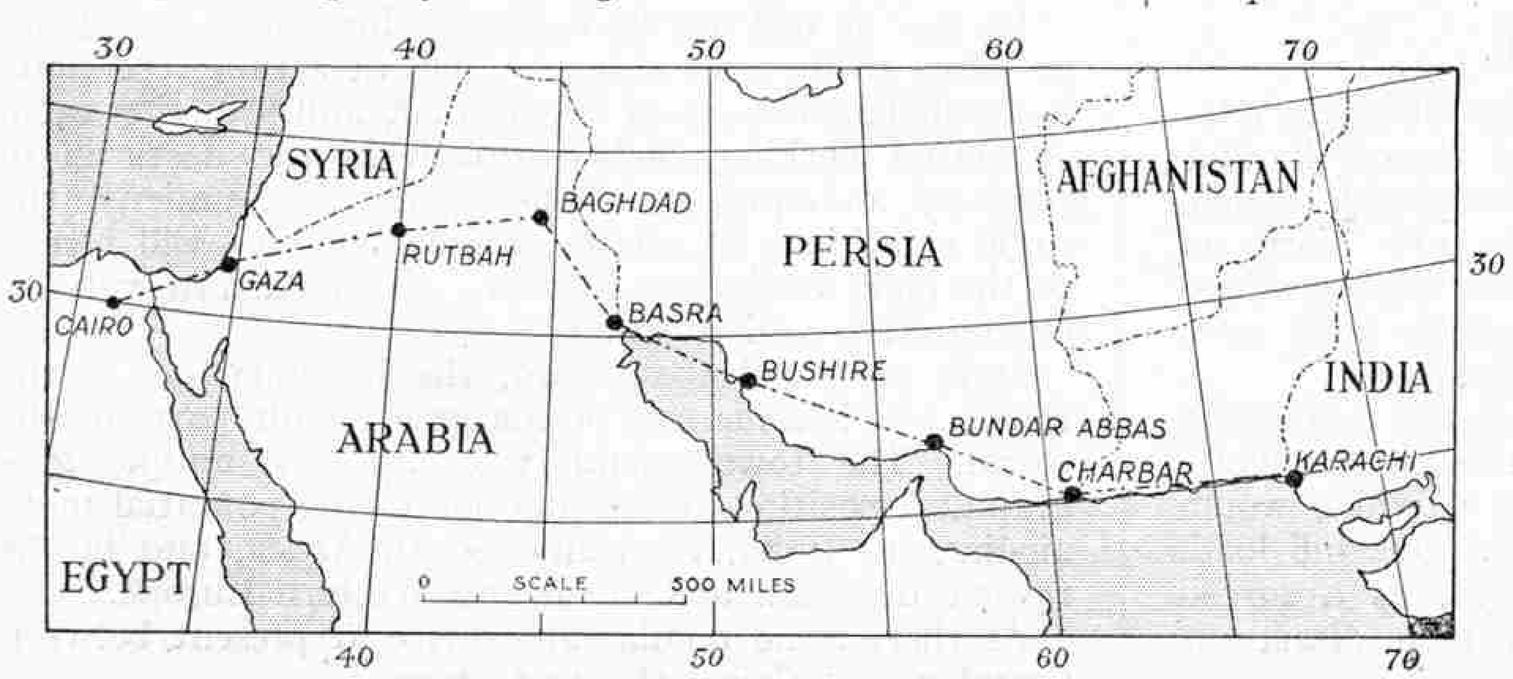
The petrol capacity is 300 gallons—sufficient fuel for a flight of up to 525 miles. This large quantity is required in view of the fact that sometimes long distances may have to be covered without landing. It is interesting to remark that the weight of petrol carried is equal to that of seven complete D.H.53 aeroplanes!

The Desert Post at Rutbah Wells

The "Hercules" carries a "paying load," excluding the crew, of 3,284 lbs., the heavy weight of petrol naturally bringing about a corresponding reduction in "paying load." In this connection it is to be remembered that reliability and good performance are the features aimed at, rather than extreme economy. During one of the test flights, however, the petrol consumption was found to be 5 gallons per hour per engine less than that of any other three-engined machine. The cabin is said to be relatively quiet, the noise being less than that experienced in the carriage of a train on the Piccadilly Railway.

The Cairo-Karachi service was opened last month, but until April the service is to operate only between Cairo and Basra, being then extended to Karachi. There is a great deal of work to be done, even yet, in connection with the ground organisation. In addition to clearing landing grounds, building aerodromes, rest houses, etc., it has been necessary to establish a post at Rutbah Wells in the middle of the desert, where a wireless station has been installed.

Despite the difficulty encountered in petrol storage in desert areas, where



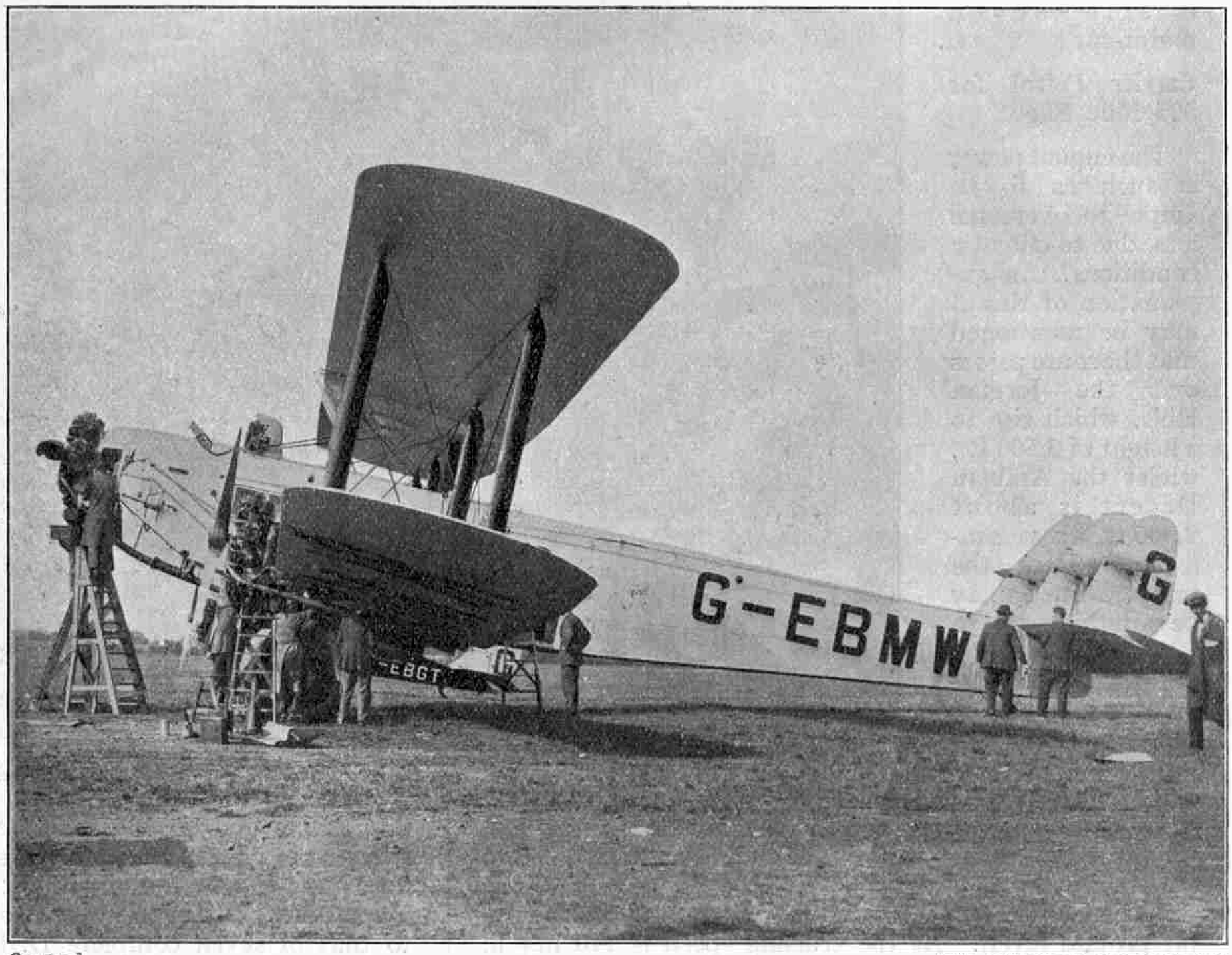
Map showing the Cairo-Karachi Air-Route

one of the greatest troubles is to prevent the sand getting into either the petrol or oil, underground petrol storage tanks have had to be established at Rutbah, from which place nothing but sand can be seen in any direction. Here the desert has a length equivalent to the distance from London to Aberdeen. Rutbah occupies the same relative position in the desert as York occupies between London and Aberdeen. The only water in this area is at Rutbah, where the water rises in the wells to some 50 ft. below the surface of the ground.

The Furrow Ploughed Across the Desert

The whole route from Cairo to Karachi is divided into two stages, with Basra approximately half way. The distance from Cairo to Basra is 1,120 miles and from Karachi to Basra 1,416 miles.

The route over the first stage is not exceptionally difficult to follow, except for a distance of about 500 miles across the Arabian Desert. A furrow, ploughed by cars of the Royal Air Force, will be a guide for the pilots, however, although in places the marks have become nearly obliterated by sand storms. If the pilot loses sight of the tracks he will be in some difficulty as there are no landmarks that will enable it to be found again. Should a forced landing have to be made at some spot that is off the usual track, there will probably be the greatest difficulty in a relief aeroplane finding the machine from the air. The fact that the visibility from the ground in summer is not more than three or four miles will further increase the difficulty confronting a search party.



Courtesy] [*The de Havil and Aircraft Co. Ltd.*

The " Hercules " being prepared for its first test flight. An idea of its size can be gained from a comparison with the D.H.9J seen on its starboard side. The two machines were standing wing-tip to wing-tip

The Wireless Chain Across the Desert

From Basra to Karachi the route lies along the edge of the Persian Gulf. Here again a forced landing would be disastrous, for in this inhospitable region there are very few inhabitants. The only form of transport is an occasional camel caravan and, perhaps, a native boat. Water is rarely available and even when found is undrinkable by Europeans.

With these unwelcome facts in view it will be realised why it was decided to operate the route with aeroplanes equipped with three engines, any two of which would be able to keep the machine in flight with a full load. Reliability is the first thing aimed at, as a forced landing in either section might easily have disastrous consequences.

As a matter of precaution, however, there are landing grounds over the desert section every 25 miles, and at other parts of the route the greatest distance between any two landing grounds is not over 140 miles. A complete wireless chain extends from one end of the route to the other, and throughout the whole of their flight the air-liners will be in communication with the ground station at each end of the particular section in which they are flying. In the event of a forced landing in the desert, the gas-starter engine (which eliminates " propeller-swinging ") is so arranged that it will drive the electric generator of the wireless transmitter, so that, theoretically, the " Hercules," both on the ground and in the air, will always be in communication with the nearest aerodrome.

Importance of Cairo as an Air Port

So that it will not be necessary for either aeroplanes or pilots to fly over long stretches at a time, the route is divided into stages of between 500 and 800 miles each. In actual working, each aeroplane in the fleet will in turn fly an equal number of miles and undergo the same conditions of service. Each machine will return to the main workshops at Cairo at regular intervals for examination and overhaul.

It is predicted that Cairo, the headquarters of the route, will become one of the greatest air ports of the world. The town certainly occupies a unique geographical position at the junction of the potential main air-lines to India, Australia, South Africa, and in the reverse direction to Central and Western Europe.

As there is no regular air-service at present between Croydon and Cairo, the first stage (*Continued on page* 163)

HOW THINGS ARE MADE—IV.

Engines for Aeroplanes

The Bristol "Jupiter" Aero-engine and its Manufacture

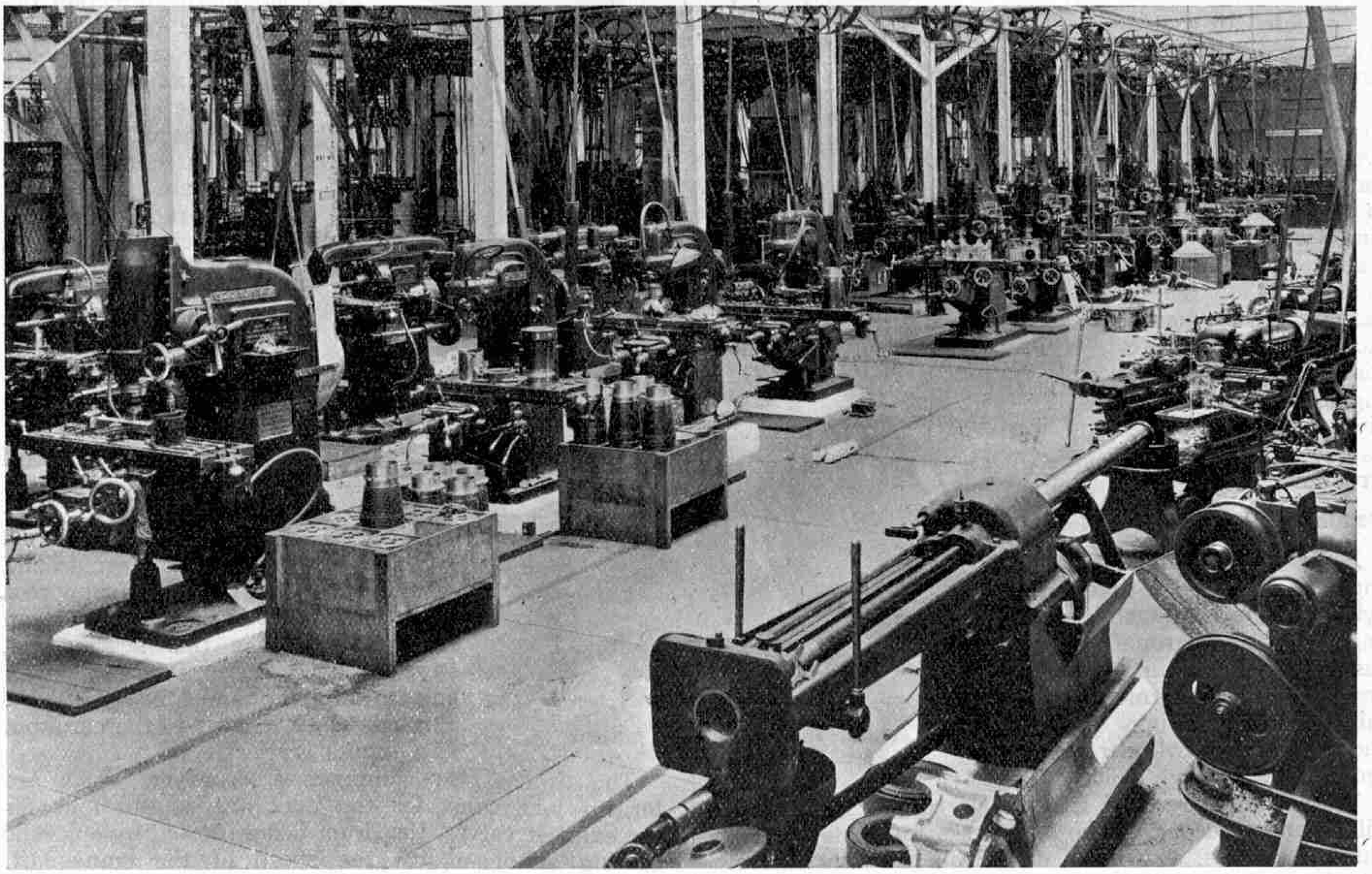


Fig. A. Milling and Broaching Machines

IN the later stages of the war, when the limit of the capacity of the air-cooled rotary aero-engine had been reached, a demand arose for a higher-powered engine. The requirements were for an engine having the same characteristics with respect to manœuvring power, compactness, and low weight, as the rotary engine, together with the reliability and economy of the water-cooled engines available at that time.

Several designs of static radial air-cooled engines were produced to meet this demand, but, although good power-weight ratios were secured, the engines of this type failed, in general, with respect to reliability. Since the war, however, static radial air-cooled engines have been through a somewhat tedious, but successful, process of development. There are now available high-powered engines of this type that will compare quite favourably with water-cooled engines on the grounds of reliability, durability, and fuel consumption.

Three Famous Engines

One of the best known of these radial aero-engines is the Bristol "Jupiter," which has been mentioned in our "Conquest of the Air" series. The excellent performances of this engine, both in long continuous runs on the bench and also in the air, have also been referred to on more than one occasion. The satisfactory results, of course, depend very largely upon the production of a satisfactory design and the employment of suitable materials of construction. These alone, however, are not sufficient to ensure a satisfactory performance under the exacting conditions in which an aero-engine is required to work. Exactly as in the manufacture of Meccano parts and Hornby Trains, it is also necessary that the manufacturing operations should be carried out so as to ensure the maintenance of an exceptionally high standard of accuracy and finish of all essential parts, if the desired characteristics of durability and reliability are to be secured in service. These points are fully realised by aero-engine manufacturers as well as by the Air Ministry, whose inspectors are responsible for the acceptance of the engines required for the Royal Air Force and the British commercial air services.

By the courtesy of the Bristol Aeroplane Co. Ltd. we are able to give some particulars in regard to the

production side of aero-engine manufacture. At the Filton works of the Company the Bristol "Jupiter," "Lucifer," and "Cherub" engines are manufactured. Of these engines, the first mentioned is of the static radial, air-cooled type and has nine cylinders and a rated output of 450 h.p. The "Lucifer," which is of the same type, has three cylinders giving a rated output of 120 h.p. The "Cherub" was designed for use on light aeroplanes and has two opposed air-cooled cylinders, the rated output of the latest model being 35 h.p. In this article, however, we propose to confine our attention to the "Jupiter" engine, which is illustrated on this page in Fig. B. Before dealing with the manufacturing operations in connection with this engine it is necessary to give some account of its design and construction.

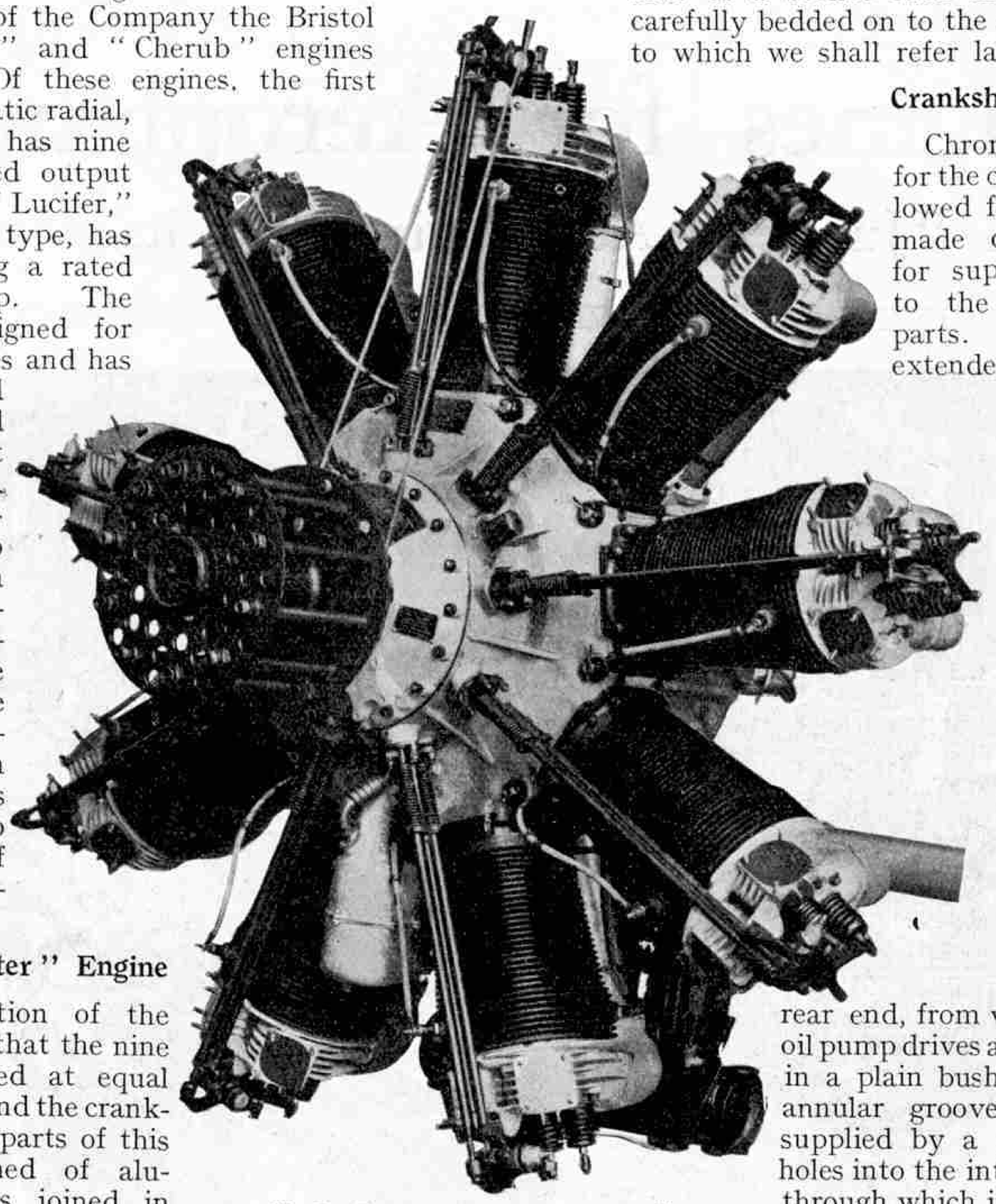


Fig. B. Front view of Bristol "Jupiter"

Details of the "Jupiter" Engine

From the illustration of the engine it will be seen that the nine cylinders are arranged at equal angular distances around the crank-case. The two main parts of this crank-case are formed of aluminium-alloy castings joined in the plane of the cylinder axes and secured by through bolts.

The cylinders are of mild steel, turned from solid billets and attached to the crank-case by studs passing through flanges, as will be clear from the illustration. The bore of the cylinders is $5\frac{3}{4}$ in. and the piston stroke $7\frac{1}{2}$ in. Slipper-type pistons, cast from aluminium alloy, are fitted, each being provided with two gas-rings and a scraper ring. The gudgeon-pins are hollow and formed of air-hardening steel. They are free to turn in their seatings in the piston, as well as in the bushed small-ends of the connecting rods. The latter are of nickel-chrome steel, machined from stampings and very highly finished. The master rod is coupled to a single-throw crank-shaft, the eight remaining articulated rods working on wrist-pins carried by the big-end of the master rod or its cap. The big-end bearing consists of a bronze shell lined with white metal, carefully bedded on to the crank-pin by a method to which we shall refer later.

Crankshaft, Cams and Valves

Chrome-nickel steel is used for the crankshaft, which is hollowed for lightness, use being made of the hollow spaces for supplying lubricating oil to the crankpin and other parts. The crank webs are extended in the direction opposite to the crank-pin, and balance weights are secured to the extensions by means of bolts.

Three roller bearings are used to carry the radial load on the crankshaft, and the thrust of the propeller, which is mounted on the forward end, is taken on a double ball-thrust washer. The shaft is tapered and splined at the forward end to transmit the torque to the propeller hub, and at the rear end, from which the magneto and oil pump drives are taken, it is supported in a plain bushed bearing. From an annular groove in this bearing, oil, supplied by a pump, passes through holes into the interior of the crankshaft, through which it flows to the crankpin and timing gear.

The timing gear comprises a drum on which are formed four cams for the inlet valves and four for the exhaust valves, the drum being rotated by epicyclic gearing at one-eighth the speed of the crankshaft.

Roller tappets, working in bronze guides, are operated by the cams, their motion being communicated to the valve rockers on the cylinder heads by means of hollow push rods, shown in the illustration. An ingenious compensating device serves to keep the tappet clearance constant, irrespective of the alteration in the length of the cylinder due to expansion.

There are two inlet and two exhaust valves to each cylinder. The valves, which are of nickel-alloy and cobalt-chrome-alloy steel, work in bronze guides fitted into the cylinder head, this being an aluminium-alloy casting, attached by means of studs to the end of the steel cylinder body in

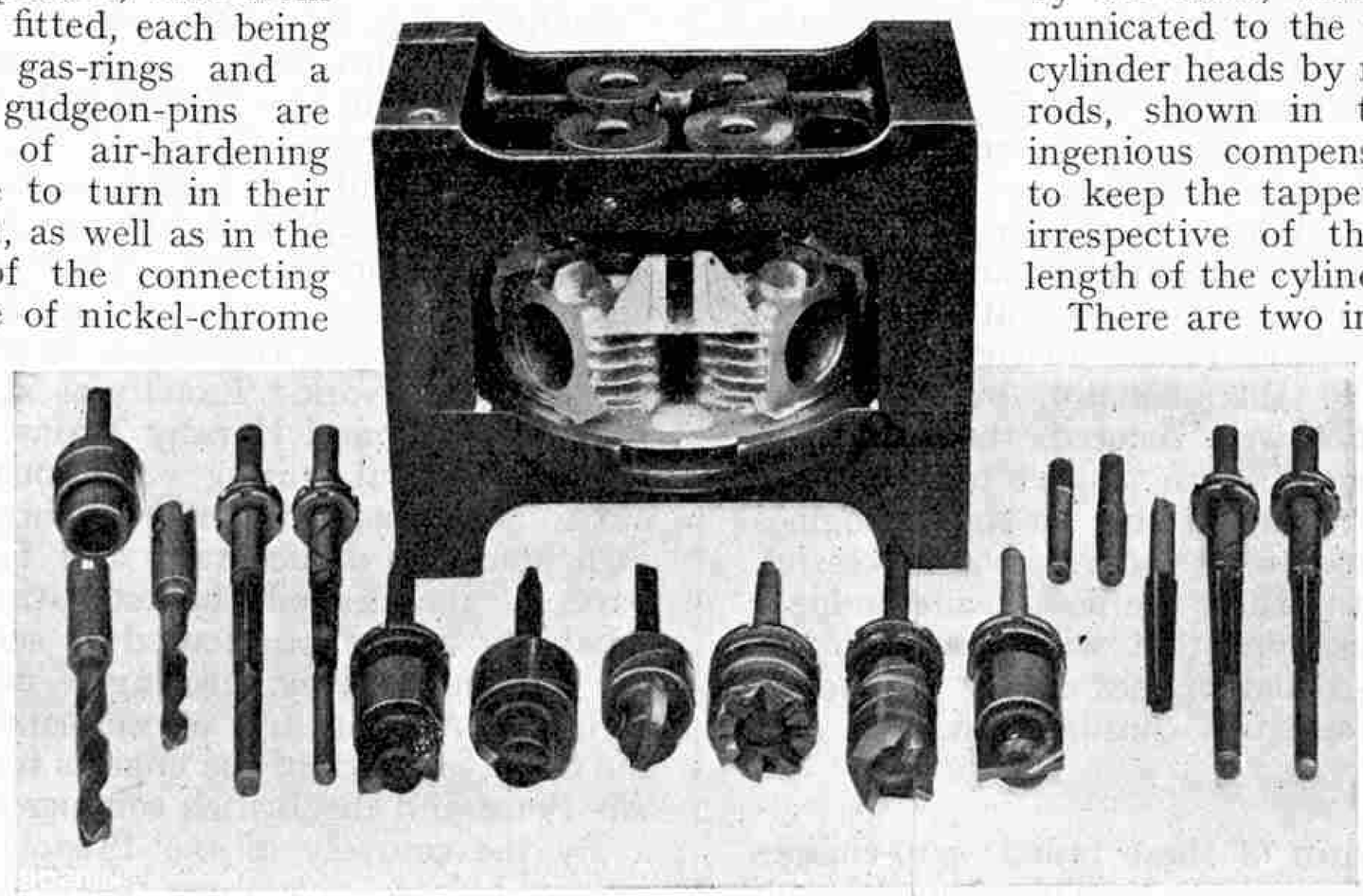


Fig. C. Jig for Drilling Valve-guide Holes in Cylinder Head

which the seats are formed.

Three Carburetters

The induction system forms a particularly interesting feature of the design. An annular chamber is formed by a recess in the back of the crankcase and a cover of semi-circular section. In this chamber is fitted an aluminium-alloy casting in the form of a ring so that when the cover is in place the chamber is divided into three sector-shaped channels. Actually these channels are helical, since the casting by which they are formed is twisted about its axis, and the pitch of the twist is such that the channels make three turns in completing the course of the annular chamber.

The three carburetters with which the engine is provided are connected to the annular chamber so that one communicates with each of the helical channels. Radial induction pipes having breeches pieces at their upper ends, connect the inlet ports on the cylinder heads with the annular chamber. As there are nine of these pipes, spaced at equal angular distances, it follows that, of each set of three adjacent induction pipes, one will communicate with each of the three helical channels.

Each carburetter therefore supplies three cylinders separated by 120 deg. By this means mutual interference between the cylinders, as they draw in their charges, is avoided, and the effects of any variations in mixture strength arising from differences in carburetter adjustment are reduced to a minimum. Moreover, the arrangement enables the engine to run on six, or even on three, cylinders with one, or two, of the carburetters out of action.

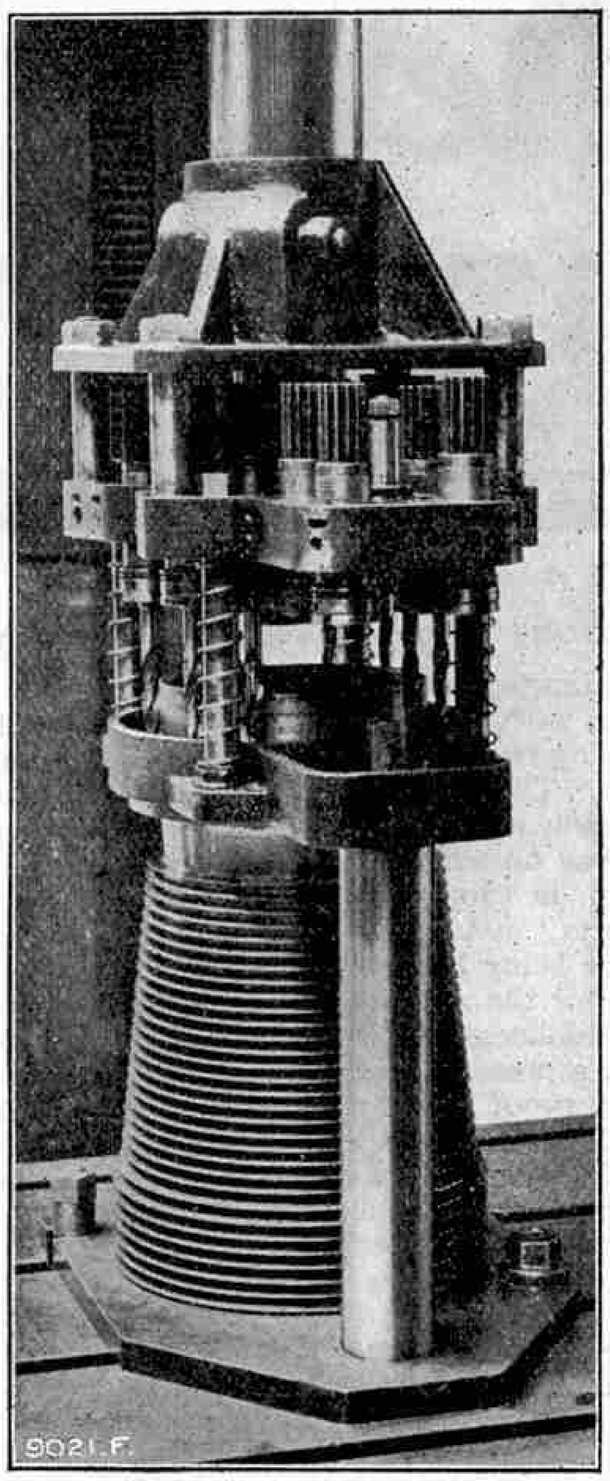


Fig. D. Jig for Drilling Bottom Flange of Cylinder

Maximum of 436 h.p. at 1,750 r.p.m.

The engine is lubricated by oil supplied from a tank located in any convenient part of the aeroplane. Oil is delivered by a gear-type duplex oil pump, at a pressure of 40 lb. per square inch, to the annular groove in the rear bearing of the crankshaft previously mentioned. The oil passes through holes into the interior of the hollow crankshaft and escapes through holes in the crankpin for the lubrication of the latter and of the wrist pins of the articulated rods.

The oil thrown off by the wrist pins serves to lubricate the cylinders and gudgeon pins on the splash system, but that from the crankpin is directed by nozzles and channels into the lower part of the crank-case, from whence it runs into the sump.

Part of the oil from the interior of the crankshaft passes out through a hole for the lubrication of the timing-gear and the main and thrust bearings, this oil also finding its way back into the sump after use. From the sump, the oil is drawn by the upper portion of the pump and returned through a filter, to the supply tank.

The normal output of 400 b.h.p. is obtained at a speed of 1,575 r.p.m., but the engine develops a maximum of 436 h.p. at 1,750 r.p.m.

The fuel consumption at the normal output is 0.57 pint, and the consumption of lubricating oil is 0.03 pint, both per brake horse-power per hour. At the normal output, the weight per horse-power works out at 1.95 lb., the total weight of the engine, without fuel or oil, being 780 lb.

The Manufacturing of the Engine

Turning now to the production of the engine, we may first recall the fact that the Bristol "Jupiter" designs and patent rights were purchased from the Cosmos Engineering Co. Ltd., when that concern went into liquidation in 1919. Before that time, the Bristol company had confined their attention to the design and construction of aeroplanes, but they then set up an entirely new department for the production of aero engines. For the purpose they acquired a number of Government buildings at the Filton Aerodrome, some 4½ miles from Bristol. The plant was laid out solely for the manufacture of radial air-cooled engines, its capacity being 300 engines per annum. Mr. A. H. R. Fedden, the original designer of the engine, is responsible both for the technical and production sides of the works. This arrangement is possible in peace time, when the demand for the engines is inevitably limited, but the organisation is such that, in the event of a sudden heavy demand arising, technical development could be continued on the existing lines and the production side greatly expanded.

The Machinery Used

There are six main departments, viz., rough-material stores, machine shops with view room, tool room and tool stores, finished stores, fitting shop, test house and stripping department.

In addition to the main shops, there is an aluminium foundry—for the production of cylinder heads, pistons and other small castings—a laboratory, a heat-treatment shop and a repair shop.

The main machine shop, a view of which is reproduced in Fig. A, is equipped with Herbert capstan lathes, Herbert bar lathes, Cincinnati millers, Cincinnati-Bickford drills, Herbert drills and Churchill grinders, some of which will be recognised by our engineering readers in the illustration mentioned.

Automatics are not employed, it being considered that there is much less likelihood of defective parts escaping notice when the parts are produced on hand capstans, with which the operator sees and handles each piece as it is machined. In confirmation of this it is interesting to find that a considerable proportion of work having slight flaws is detected by the operators and thrown out before passing on to the view room.

Next month we shall deal with some of the technical operations involved in the manufacturing processes.

(To be continued)

A Nature Study

The little creature shifted uneasily, still keeping an eye on the strange phenomenon below. Its attitude seemed to say, "this is certainly something unusual."

I felt sorry for the dainty little thing because, although its way of escape was easy, it seemed drawn irresistibly by some fascination, to come so near to what I knew would shortly be an explosion.

I was not disappointed: there was a harsh grinding sound, and without warning a crimson and yellow tongue of flame spat forth into the semi-gloom. I smelt the nauseous fumes, and as they rose, a cloud of poisonous grey vapour, my eye travelled to the dainty creature so near to the seat of the explosion.

It had already moved to a safer distance, but was still unaware of what was to follow. It hesitated, as if the animal instinct of safety first was being held in check by a sort of feminine curiosity, perhaps the fascination of the unexplained.

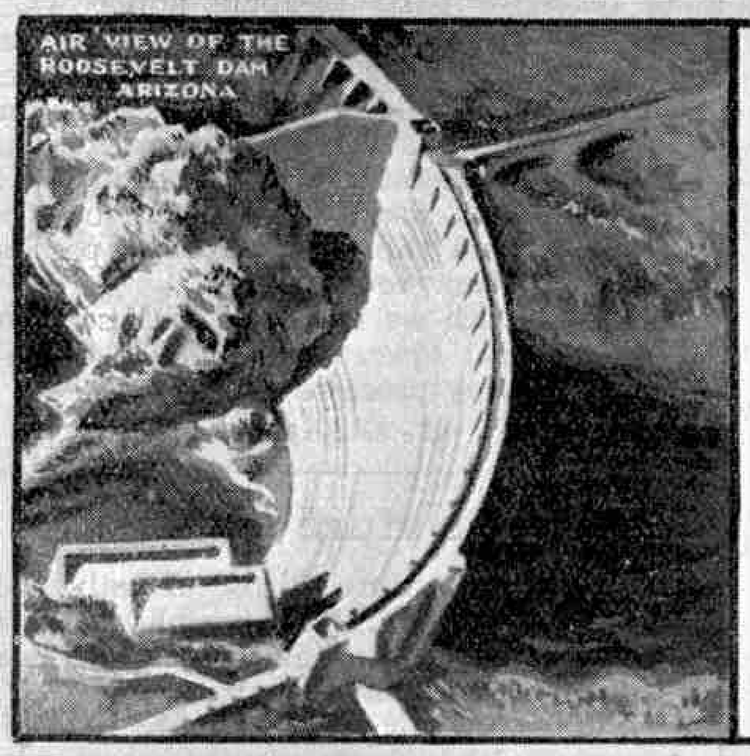
I watched the flame getting nearer and nearer to the blackened circle as it had done many times before. It dwindled as if some force was sapping away its substance, absorbing its burning and radiating heat; but as I watched, it seemed by an effort, to gain flickering strength, to take on a new energy, to infect like some contagious disease, the area immediately below it.

Ruddier and brighter grew the conflagration as the wind took part in this game of elemental forces. The clouds of vapour and smoke began to drift in my direction. I looked round for a safe road of escape, and as I retreated before this spreading terror I looked round for my dumb companion, but the fly, which I had been watching, had taken to its wings, and Mr. Poole, whose pipe was now working to his entire satisfaction, shut up his desk and prepared for the journey home to tea.—"A.T.P." in "*Edgar Allen Works Magazine.*"

Free Copies of "The Wireless World"

It will be of interest to our readers to learn that "The Wireless World" is offering to send a free specimen copy to any bona fide enquirer. Enquiries for specimen copies should be addressed to the publishers of "The Wireless World," Dorset House, Tudor Street, London, E.C.4, mention being made of the "*M.M.*"

"The Wireless World" has for many years been a recognised authority on radio matters and has always enjoyed a very high reputation throughout the world for the soundness of its views and the dependability of its technical descriptions. A very efficient Service Department has been organised to deal with readers' difficulties, and many thousands of enquiries are dealt with each week, no charge being made for this service. Yet another department is devoted to experimental work and the designing of constructional sets, which readers can build up from the components specified. These sets are always very thoroughly tested before the drawings and descriptions are published, and they may therefore be relied upon to give satisfactory results when in use.



Engineering News of the month.

Concrete Suspension Bridge

The newest application of reinforced concrete is to an engineering proposition that seemed likely to be for ever the sole preserve of steel—the suspension bridge. In the course of the reconstruction of Laon, one of the French towns that played a prominent part in the War, it was necessary to construct a viaduct in the approach to the railway station and to extend this across the railway itself by means of a suspension bridge.

The bridge is approximately 230 ft. in length and in place of the usual steel cables the central piers carry iron rods embedded in concrete. The vertical iron rods carrying the platform are also covered with concrete and attached directly to the suspension rods. In actual fact, therefore, the bridge is suspended by metal, although it is encased in concrete to ensure durability and incidentally to harmonise with the appearance of the remainder of the work.

* * * *

A Huge Crane

A crane now being erected at the works of the Carnegie Company will be the largest steel span crane in existence when completed. Its projected capacity is 275 tons and it is intended to be used for lifting out and changing complete rolling mills, instead of changing only the rolls as is the usual practice.

* * * *

The World's Biggest Tunnels

With the completion of the new Mersey Tunnel, the preliminary work for which is now in hand, Great Britain will possess both the widest and the longest tunnels in the world.

The inside width of the Mersey Tunnel will be approximately 44 ft., nearly twice the width of the Blackwell Tunnel under the River Thames. The longest tunnel in the world is the South London tube running from Golder's Green to Morden, a distance of 15 miles. The nearest approach to this is the Simplon Tunnel beneath the Alps, which is 12¼ miles in length, the other famous Alpine tunnels, the St. Gothard and the Mont Cenis, being respectively 9¼ and 8 miles in length. Perhaps the most remarkable tunnel in the whole world is the Otira Tunnel, New Zealand, whose 5½-mile length follows a perfectly straight line through the mountain, so that it is possible to stand at one end and see daylight at the other.

Rubber Road Surfacing

Very little success has attended experiments in surfacing roads with rubber, but a new process is now being tried out in New Bridge Street, London. The road on which the experiment is being made consists of a 12-inch concrete bed on which is laid a cushion of sand, ¾ in. in thickness. Heavy blocks of terra-cotta, 10½ in. in length by 8 in. in width, are being laid on the sand to serve as a base for the rubber, which will be ⅝ in. in thickness. The rubber will be laid on by a process which, it is claimed, will make it proof against the pounding and spreading tendencies set up by the heaviest traffic. The terra-cotta blocks are set in with joints of a specially prepared bitumen and rubber mixture. The proprietors of the process, a Manchester firm, have laid the road down and will maintain it for two years, after which if it is satisfactory, the city authorities will take over the road and maintain it themselves.

In a private test a similar section of roadway was subjected to the passage of a 13-ton steam lorry, which crossed and recrossed a thousand times in the course of one day. The sides of the road had been prepared with granite and were completely destroyed, while the rubber and terra-cotta blocks still held.

The use of terra-cotta for roadwork is by no means new. Excavations have revealed that the Romans used it very extensively in preparing their famous roads, while the same material was also used in making pavements.

* * * *

Polish Mercantile Fleet

Five 3,000-ton cargo ships have been purchased by Poland from French builders to form the nucleus of a mercantile fleet that will be operated by the State. Three of the vessels have been engaged in the coal trade between England and France and two are still under construction.

* * * *

New Sudan Bridge

A contract for the construction of a large bridge over the river Albara in the Sudan has been placed with Dorman, Long & Co. Ltd., of Middlesbrough. Complete details are not available but the anticipated cost of the structure is between £70,000 and £75,000.

Chilian Hydro-Electric Scheme

A concession for the construction of a hydro-electric plant on the river Bio-Bio, near Concepcion, has been granted by the Chilian Government. The plant will be installed close to a waterfall and it is estimated that the maximum power obtained will be between 3,000 and 4,500 h.p., while the average will be from 900 to 1,200 h.p. The current will be conveyed by overhead transmission wires to Concepcion, the chief trading centre in Chili, and to the port of Talcahuano, nearly 35 miles away, and will be supplied both for industrial and lighting purposes. The estimated cost of the complete installation is £100,000.

* * * *

Another Giant Motor Liner

A new motor liner of 35,000 tons, the largest in the world, has recently been launched from the Sestri Potente shipyards at Genoa. The new vessel is named "*Augustus*" and has been designed for the South American service. It is stated that she will be one of the most luxurious ships afloat.

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Orders have been placed by the Norddeutscher Lloyd Company for two liners, each possessing a gross tonnage of 46,000. These vessels are intended for the Transatlantic service and will occupy from five to six days for the trip from Europe to New York.

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Kenya Colony Transport Scheme

Kenya Colony is to receive £4,300,000 from the Imperial Government's £10,000,000 guarantee loan for East Africa and recently the Government of the colony adopted a scheme for the allocation of this sum.

Four new deep-water berths in addition to coal and oil piers, are to be provided at Kilindini. A total of £2,000,000 is to be spent at this port and £300,000 of this will be required for offices and equipment on the existing wharves and for houses for workmen and officials. The remaining £2,300,000 is to be spent on improving and relaying the railways, the construction of new branch lines leading from the Mombasa main line, and the provision of locomotives and rolling stock

Anglo-Persian Oil Company's Fleet

The completion of orders for nine new ships placed last year with various British firms by the Anglo-Persian Oil Company will increase the strength of the company's fleet to 80 vessels. The new ships consist of seven of 10,000 tons deadweight and two of 6,400 tons. These orders bring the total of new ships ordered by this company in the last year up to eighteen, totalling 170,000 tons capacity, and the company's total tonnage is now 700,000. Few ships of this fleet are older than eight or nine years and all have been built in British yards.

* * *

Mammoth Turbo-Generators

Three of the largest turbo-generators ever constructed are at present being built at the General Electric Company's works at Schenectady, U.S.A.

Two of these units are for the Southern California Edison Company, Los Angeles, and will have a rating of 100,000 h.p. Each will produce current at 16,500 volts when running at 1,500 r.p.m. The size of these generators is such that it has been found impossible to transport the armatures in an assembled state to their destination, for each weighs 330,000 lb. or approximately 150 tons!

The third generator is destined for the State Line Generating Company's new station on Lake Michigan, the capacity of which will eventually reach 1,000,000 k.w. It is designed to supply at 18,000 volts when rotating at 1,800 r.p.m.

* * * *

Non-Stop to 82nd Floor

Preparations are being made for the erection in New York of what is termed a "Mammoth Super-Skyscraper," 1,208 ft. in height and possessing 110 storeys, at an estimated cost of £2,600,000. This will be 56 storeys higher than the famous Woolworth Building. The new skyscraper will be known as the Larkin Tower and will provide office accommodation for 30,000 people.

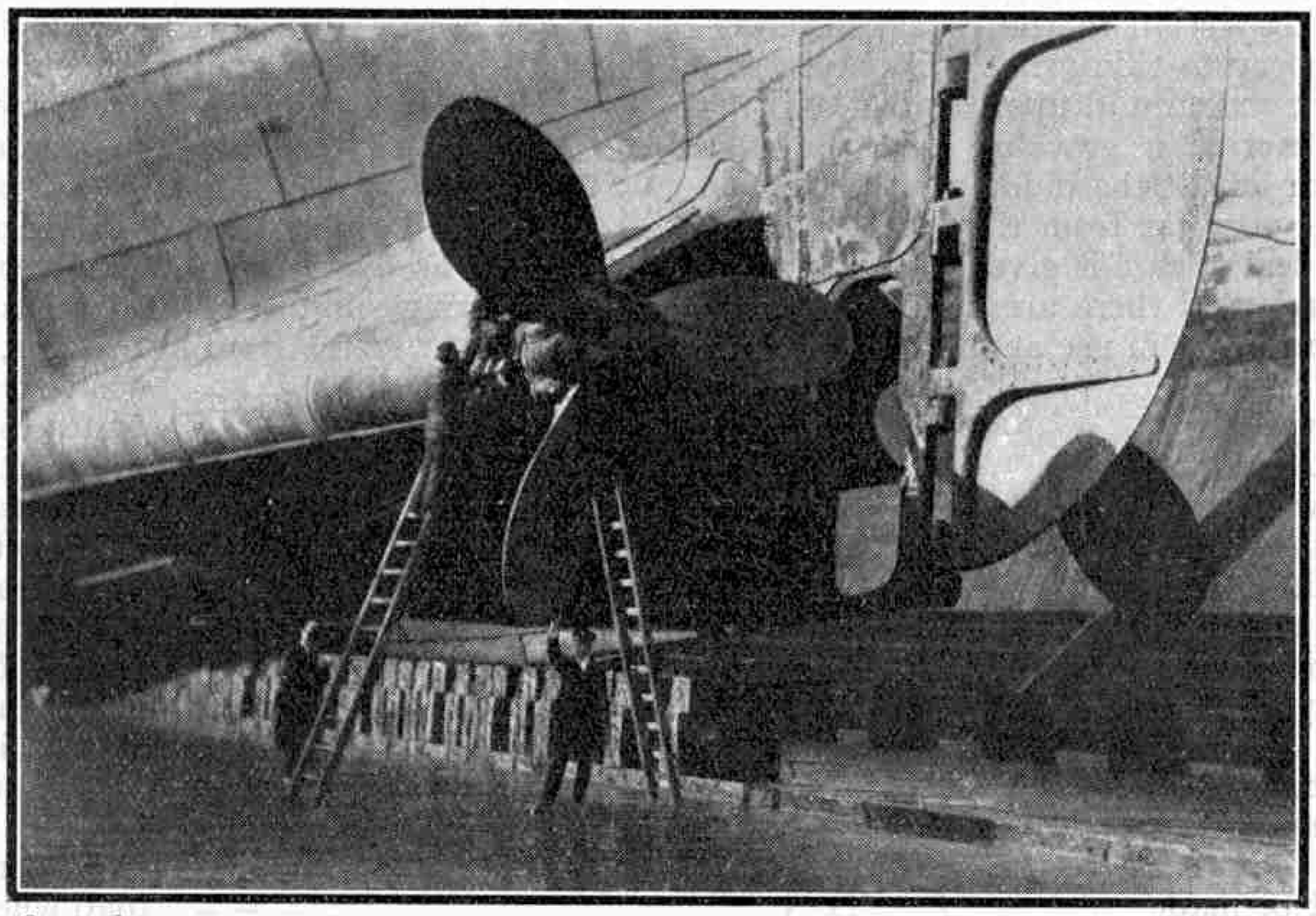
Sixty express lifts arranged in 10 batteries of six lifts each will be installed to convey tenants from the ground floor to their offices among the clouds. Two of the lifts will be run non-stop to the 82nd floor.

Excavations for the foundations will have to be made in rock 48 ft. below the street level, and the building will rest on a heavy grillage that will be embedded in 18 ft. slabs of reinforced concrete anchored to the solid rock.

It is interesting to note that the building will stand some 200 ft. higher than the Paris Eiffel Tower and nearly seven times higher than the Nelson Column in Trafalgar Square.

Further details of this huge building will be published later when the final designs have been prepared and passed.

The "Mongolia" in Dry Dock



Courtesy ["*Ocean Ferry*"

This photo, taken by the Chief Steward of the "Mongolia," shows the great size of the modern liner. Driven by twin screws, with plenty of power in the engine-room, the "Mongolia," one of the Panama-Pacific liners, makes her 5,000-mile voyage from coast to coast with the regularity of an express train. Few travellers visualize the massiveness of the machinery that drives the 26,000 tons of weight in the hull and cargo of these ships.

Widening Manchester Ship Canal

The steady increase of traffic on the Manchester Ship Canal has necessitated widening operations to provide a further point at which ships may pass. The point chosen is Bobs Bridge near Runcorn, and a new berth 30 ft. in width and 1,100 ft. in length is to be provided. Excavation work has been proceeding for some time and among the plant in use is a specially-designed dragline capable of raising three tons of clay from 20 ft. below water level and moving it 100 ft. to trucks ashore, in 55 seconds.

* * * *

Submarine's 20,000-Mile Trip

The Dutch submarine *K.13* has recently arrived in Dutch East Indian waters after a journey of nearly 20,000 miles from Amsterdam, via the Panama Canal. The distance is the longest ever accomplished by an unconvoyed submarine.

* * * *

The hydro-electric plant that is being built on the St. Anne River at St. Alban, Quebec, will develop 4,000 h.p. and the estimated cost is £120,000.

Electrical Progress in Europe

Some interesting details regarding electrical progress in Europe were given by a lecturer at a recent meeting of the Institute of Electrical Engineers. Switzerland was considered to have made the biggest strides in the use of electricity. In 1914 less than 65 per cent. of the houses in the chief Swiss cities were electrified; the percentage had now grown to 98, and the average of the whole country was 95 per cent. The increase in the use of electrical power is still maintained and it is anticipated that 64 per cent. of the railways will be electrically operated by the end of this year.

Austria and Germany also have increased their use of electricity and although progress in domestic use has been comparatively small, the electrification of railways has been an important feature in these countries since the war. Some of the supply companies in Germany transmit power over a distance of 300 miles.

* * *

Electrical Power of Canada and U.S.A.

A joint board of Canadian and United States engineers have been considering the development for navigation of the Great Lakes and the St. Lawrence, but have been unable to reach a decision. The plans advocated by the Canadian engineers involve an expenditure of approximately 309,000,000 dollars, while the American engineers estimate an expenditure of 290,000,000 dollars to achieve similar results by other means. The estimated cost of improving the St. Lawrence for navigation is 168,000,000 dollars under either scheme. At present the river is liable to freeze up in winter.

* * * *

The Mendota bridge, spanning the Minnesota river, U.S.A., was recently thrown open to traffic. The bridge has thirteen spans, is 4,119 ft. in length and 120 ft. in height, and is constructed throughout of reinforced concrete.

* * * *

A new cable intended primarily for telephone communication, but available also for telegraphic working, has recently been laid by the New Zealand authorities across Cook Strait between the North and South Islands, a distance of approximately thirty miles.

Steering a Motor Car

A Meccano Demonstration of the Mechanical Principles Involved

By Edgar Wright

This article describes not only the more important mechanical principles involved in steering a motor car, but also a Meccano model that clearly demonstrates the working of Ackermann steering gear. The model is quite simple to construct and is so designed that it may be incorporated without alteration in the existing Meccano motor chassis (Model No. 701).

THE design of motor car steering gear is not nearly as simple as it may seem to the casual observer.

Many people appear to think that it is only necessary to twist the front axle round upon a pivot and the car will promptly describe a graceful curve or take sharp turns to right or left at the bidding of the driver. This idea of course is very far from the truth. In designing a car a great deal of care is given to this important part of the control, and there are many variations in the different steering gears in use at the present time. Every steering gear, however, must fulfil three very important requirements, which may be briefly dealt with here.

First, it is necessary that there should be as little play as possible between the road wheels and the steering wheel —that is to say, the smallest movement of the steering wheel should produce almost instantaneous movement of the road wheels. On the other hand, allowance must be made for small irresponsible movements of the road wheels themselves. These movements are due to surface inequalities in the road, and must not transmit undue shocks or vibrations to the hands of the driver.

Second, after a car turns a corner the wheels should tend of their own accord to return to the straight. The rear driving wheels naturally tend to travel in a straight line and in a well-built car this tendency can usually be relied upon to bring the front wheels back to their normal position. In this connection it should be stated, however, that many conflicting opinions have been held in the past on the subject of "irreversibility" of steering gear.

The "Irreversible" Control

The "irreversible" type of control is that in which the steering wheel can easily turn the front wheels, but the latter can with difficulty turn the steering wheel. This result is effected by worm gearing fitted between the steering wheel and the linkage and the degree of irreversibility obtained depends on the pitch of the worm.

It has been decided that the completely irreversible steering gear is not satisfactory, because the steering wheel becomes "dead" and the driver loses his "feel" of the road. In addition, great stresses are introduced in the linkage, for every shock to the front wheels is opposed by a completely rigid mechanism.

Owners of Meccano outfits will understand these points better if they construct the Meccano model of a motor chassis and experiment with different types of steering gear. For example, if worm gearing is used between the steering column and the transverse shaft that conveys movement to the front stub axles, it will be found that, while the wheels can be turned quite easily by the steering wheel, their position cannot be altered by grasping the wheels themselves with the intention of turning their axles about the pivots. The pitch of the Meccano Worm is so small that the gear is completely irreversible.

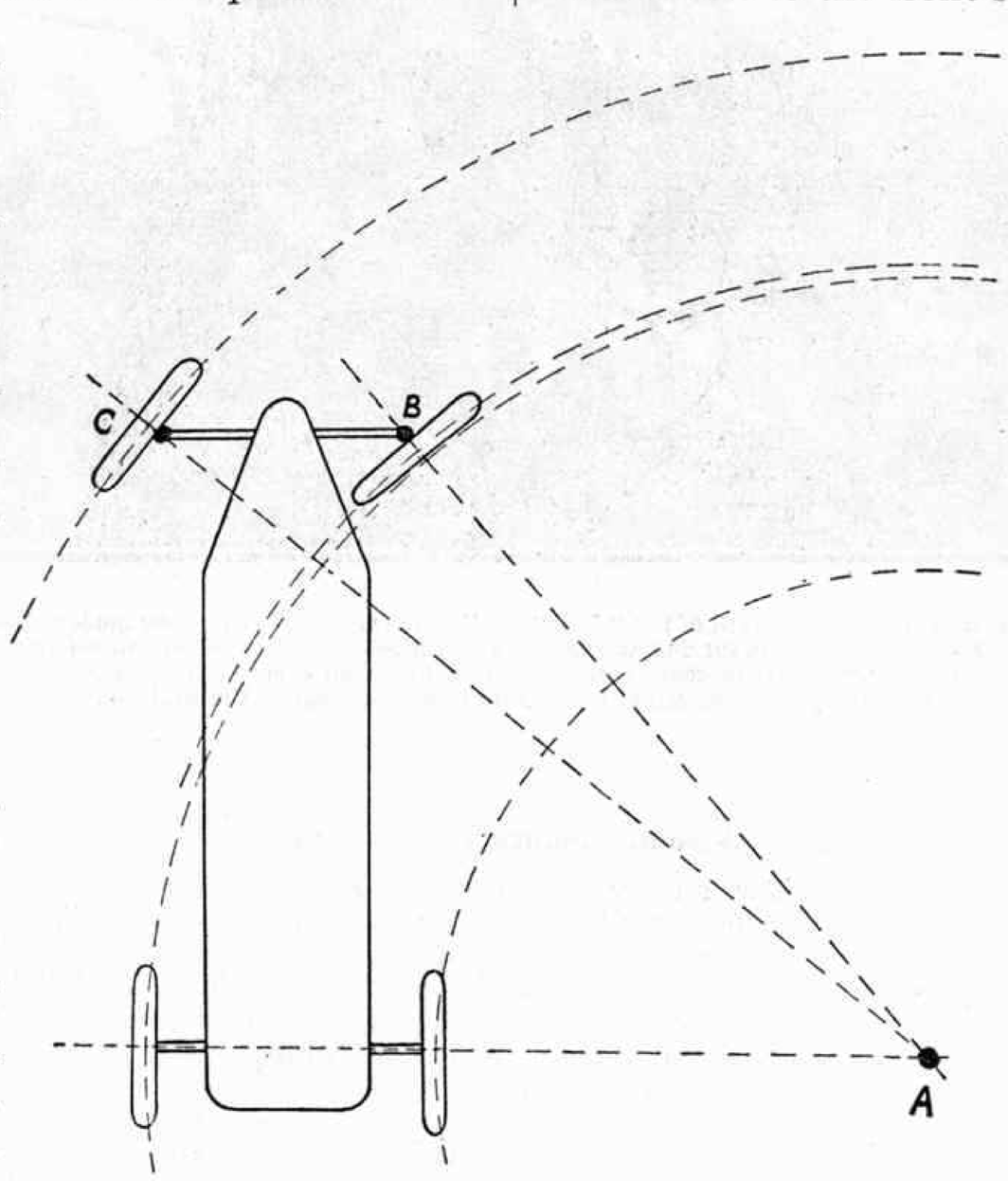


Fig. 1

But suppose we substitute for the worm gear a Pinion and Contrate Wheel. The road wheels can now be moved either by turning the steering wheel or by touching the wheels themselves. In practice the "reversibility" of such a steering gear would be too great; the road wheels would be deflected by the smallest shock or bump, and the steering wheel would be difficult to hold while the car turned a corner. Therefore a happy medium between these two results is obtained by employing a worm of moderately large pitch. The greater portion of any shock to the wheels is then absorbed in friction, but a slight tendency to twist is imparted through the pinion and worm to the steering wheel. Such a compromise in the gear arrangement also allows the wheels to "straighten out" if the wheel is released after the car has turned a corner. At the same time the wheel is not difficult to hold while the car is actually cornering.

What Happens when Turning

Third, and this is an important point—the wheels must not remain parallel when negotiating a curve. Many readers may not have given much consideration to this point—indeed, some may not have given it even a thought, but a reference to Fig. 1 should make the

statement clear.

The drawing is intended to represent a car turning a corner, and in doing so it will be apparent that the wheels must describe an arc or portion of a circle whose centre point is shown at A. Now although both front wheels must turn about this centre, they are situated at varying distances from it. This means to say that the right hand front road wheel must follow an arc of a circle having a radius equal to A B, and the left hand wheel must follow an arc struck from a larger radius A C. For the wheels to describe an arc of a circle with the least possible friction on the road surface each must be situated at a tangent to its respective circle. But it is obvious that both wheels cannot lie at their respective tangents and at the same time remain parallel with each other.

Hence it becomes necessary to incorporate in the steering gear some method by means of which a greater angle can be given to the wheel nearer the centre of the circle, whether the car be turning to right or left.

The principle by which this object is achieved is known as Ackermann steering. This interesting apparatus can be reproduced perfectly in Meccano, and its operation should be made clear by reference to Figs. 2 and 3. The model shown therein is designed for incorporation in the Meccano motor chassis (Model No. 701 in the Meccano Complete Manual). Fig. 3 is a plan view of the fixed front axle and stub axle mountings, while Fig. 2 is a general view of the complete steering gear. Two short levers, 1 and 2, are rigidly connected to the stub axles. In practice these levers may project either forward or backward; in the model they project backward or *behind* the road wheels. They are connected one to the other by the tie rod 3.

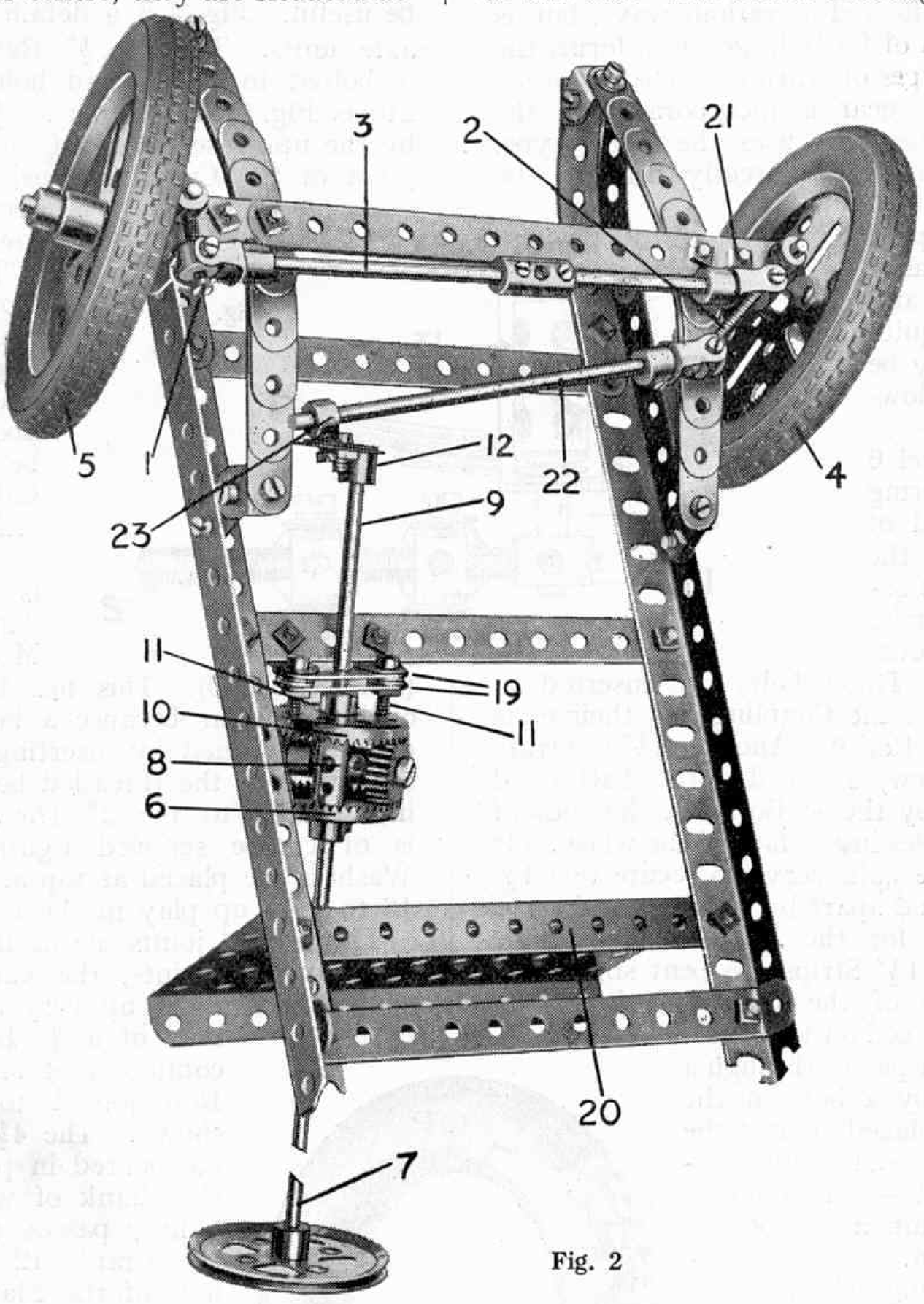


Fig. 2

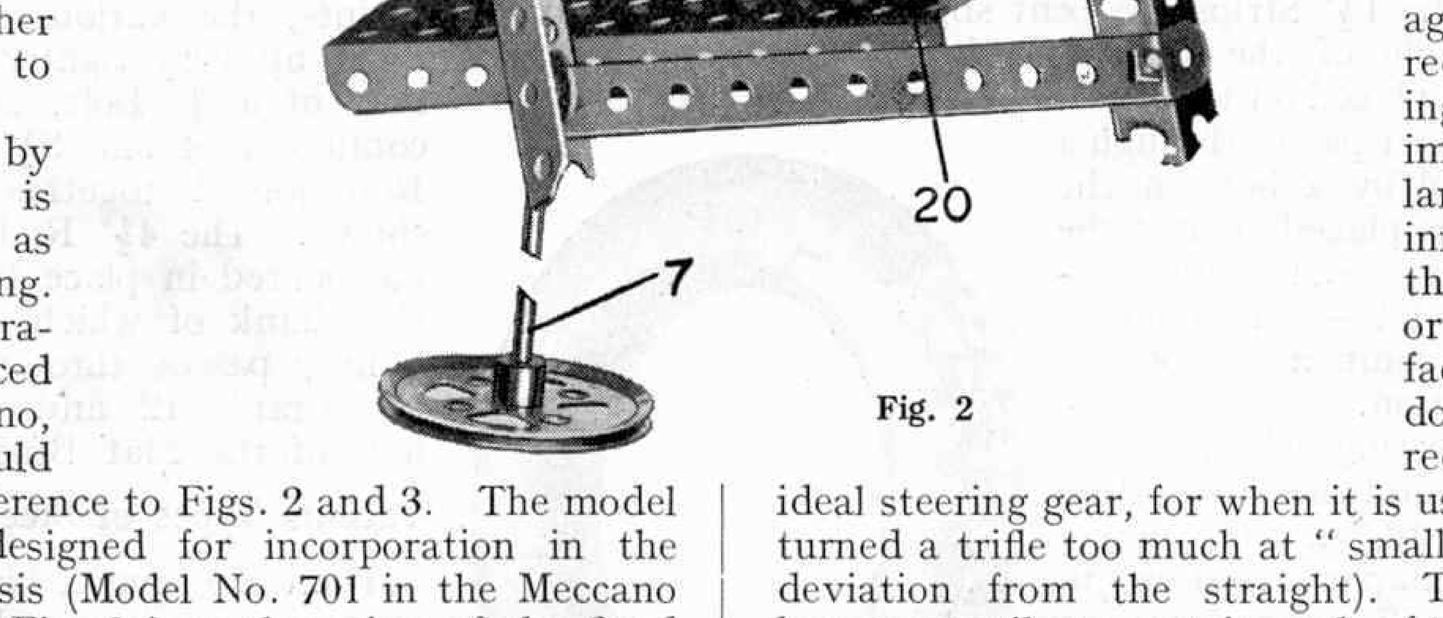
Principle of Ackermann Steering

It will be noticed that the levers 1 and 2 lie at a slightly obtuse angle to the stub axles (see Fig. 3). This angularity is most important, for on it rests the whole principle of Ackermann steering. The correct angle for the levers is arrived at by placing them so that their centre lines, if produced, would meet on the centre line of the car. The exact meeting place varies according to the proportions of the car and length of the levers, but as a rule it is found to be just in front of the back axle.

Now if the car is to be turned to the right the road wheel 4 (Fig. 3) must be deflected in that direction and the lever 2 will be moved through a certain number of degrees to the left. In doing so it pushes the lever 1 in the same direction but owing to the difference in angularity between the two levers, lever 1 (and therefore the road wheel 5), moves through a lesser number of degrees. If the car moves to the left, exactly the opposite occurs, the lever 1 moving through a greater number of degrees than the lever 2.

Therefore this arrangement of the linkage fulfils the third requirement of the steering gear, that is, it imparts a greater angular movement to the inner road wheel when the car turns to right or left. As a matter of fact Ackermann gear does not fulfil all the requirements of the ideal steering gear, for when it is used the outer wheel is turned a trifle too much at "small lock" (that is slight deviation from the straight). The error diminishes however until at a certain angle of the wheels the steering is perfect, but at still greater lock the inner wheel is turned a little too far in proportion to the angle of the outer wheel.

Fig. 3



We now come to the design of the gearing between the steering wheel and the road wheels. The gear ratio, or extent of movement of the road wheels to a given movement of the steering wheel depends largely on the particular type of car. If the ratio is too high, however, a slight twist of the wheel will result in a considerable

deflection of the car which would be dangerous and might easily cause accidents. On the other hand, if the ratio is too low the car would be slow to respond to the wheel and therefore difficult to manage in dense traffic.

Epicyclic Reduction Gear

The gear reduction is effected in various ways, but as already indicated a worm of fairly large pitch forms the basis of the more usual types of gearing. In some cars a small epicyclic reduction gear is incorporated in the steering column. The Ford car uses the latter type, the gear casing being mounted directly beneath the steering wheel.

The reduction gear adopted in the Meccano model is based on the epicyclic principle, and to make its operation quite clear the photograph may be supplemented by the following brief explanations :—

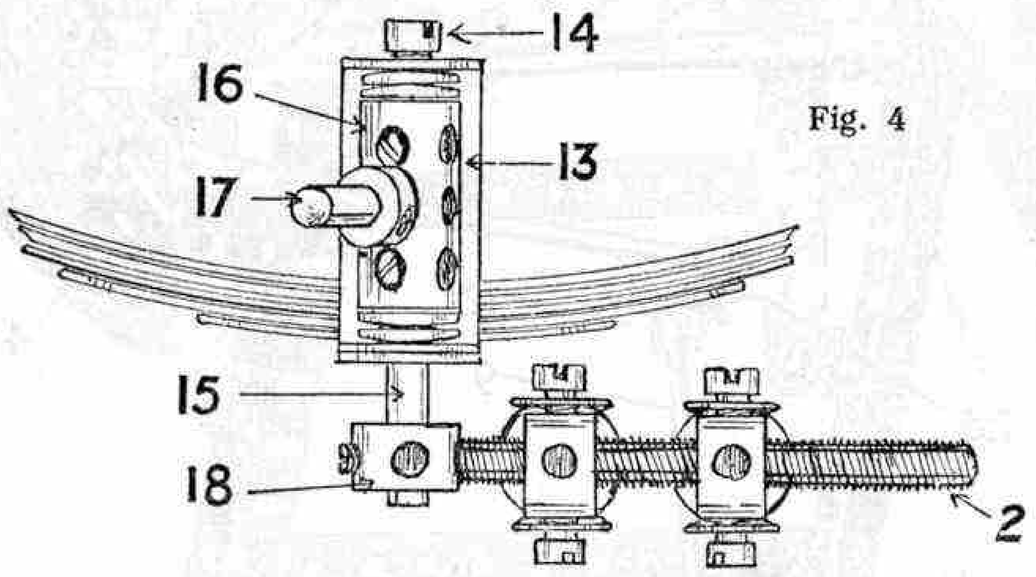


Fig. 4

The $1\frac{1}{2}$″ Contrate Wheel 6 is bolted rigidly to the steering post 7, the extreme end of which is free to rotate in the Coupling 8. The latter is secured to a 3″ Rod 9 and carries two 25-teeth Pinions journalled on Pivot Bolts. These bolts are inserted in opposite threaded holes of the Coupling and their ends grip the extremity of the Rod 9. Another $1\frac{1}{2}$″ Contrate Wheel 10 (without set-screw) is placed on the shaft 9 and prevented from turning by the $\frac{1}{2}$″ Bolts 11, the ends of which enter two of the holes in the face of the wheel. It will be noticed that these bolts serve to secure two $1\frac{1}{2}$″ Strips 19, which are spaced apart by Washers and serve as a reinforced bearing for the Rod 9. The Angle Brackets supporting the $1\frac{1}{2}$″ Strips are bent slightly to conform with the angle of the steering column. A Collar and set-screw is placed on the steering post 7 where the latter passes through a further bearing, formed by a hole in the plate 20. The Collar is placed against the inner side of the bearing—i.e., the side nearest the Contrate Wheel 6—and so serves to hold the various components of the reduction gear in position.

Rotation of the steering wheel causes the $\frac{3}{4}$″ Pinions to roll round the teeth of the fixed Contrate Wheel 10, and the movement of the Pinions imparts motion, in turn, to the Coupling 8 secured to the Rod 9 (which carries the steering drop lever 12, consisting of a Meccano Crank reinforced by a Flat Bracket). With this particular gearing a reduction ratio of one in two is obtained between the steering wheel and the shaft 9. In actual practice the reduction is greater, owing to variations in the design and number of teeth in the gearing, but a much more complicated mechanism would be required in the Meccano model in order to increase still further the difference in speed between the shafts 4 and 9.

The steering gear illustrated will be found to work very well in Meccano models, for its reversibility is neither too great nor too small, and a reasonable speed reduction is provided between the steering wheel and the road wheels.

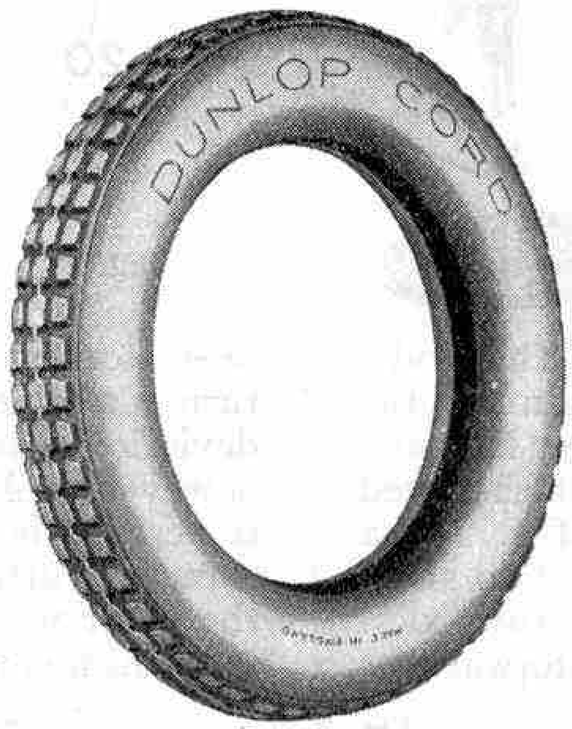
Further Details of the Model

The construction of the remainder of the Meccano model of Ackermann steering gear will no doubt be clear from the illustrations, but further particulars regarding the mounting of the front wheels, etc., may be useful. Fig. 4 is a detailed view of one of the stub axle units. The $1″ \times \frac{1}{2}″$ Reversed Angle Bracket 13 is bolted to the second hole of the fixed front axle 21 (see Fig. 2) and supports a $\frac{1}{2}$″ Bolt 14, which is gripped by the upper set-screw of the Coupling 16. The lower pivot of the Coupling consists of a 1″ Axle Rod 15, secured by means of the lower set-screw.

The stub axle 17 (a $1\frac{1}{2}$″ Rod) is fixed in the centre transverse hole of the Coupling 16. Each front road wheel must be free to turn about its axle but should be held in place by two Collars, mounted one on either side of the wheel boss.

It will be noted that 18 is the centre collar, or "spider," extracted from a Meccano Universal Joint (Part No. 140). This has been used in place of an ordinary Collar because a better grip on the Rod 15 can be obtained by inserting one, two, or even three set-screws in the threaded borings of the special collar in addition to the 2″ Threaded Rod 2. The latter is of course screwed tightly into the collar. Two Washers are placed at top and bottom of the Coupling 16 to take up play in the bearings.

The several joints in the linkage consist of portions of Universal Joints, the various set-screws of which should be screwed up very tightly. The lever 1 consists of a $\frac{3}{4}$″ Bolt, and the tie-rod 3 is composed of one $3\frac{1}{2}$″ and one $2\frac{1}{2}$″ Axle Rod joined together by the Coupling shown. The $4\frac{1}{2}$″ Rod 22 carries a Collar 23 secured in place by an ordinary bolt, the shank of which, before entering the Collar, passes through the end hole in the Crank 12 and through the round hole of the Flat Bracket bolted thereon.



The new Miniature Dunlop Tyre used in this model. See announcement on page 155

Various Types of Steering Gear

There are several kinds of steering gears in common use in addition to the worm and bevel types already mentioned (the latter type being represented in Meccano by means of Pinion and Contrate Wheel gear, as in the well-known Meccano model Motor Chassis).

One form of steering mechanism sometimes met with makes use of plain rack-and-pinion gear, wherein a spur pinion engages with a rack that, in turn, is connected to the steering arm by means of a link-rod.

A crude form of steering apparatus used in the early days of motoring was operated by a wire cable attached to the front wheels and passed around a bobbin secured to the steering wheel shaft. On rotation of the steering wheel, the cable was wound on and off the bobbin, thereby imparting the turning movement to the road wheels.

Competition Page

Which are the Eight Most Popular "*M.M.*" Features?

In last month's issue, on this page, we offered every reader the opportunity of criticising the present features of the "*M.M.*" and it is our intention this month to afford those readers who are too modest to enter an essay contest a chance to register an opinion.

Certain features appear in the "*M.M.*" regularly each month, others appear frequently though not quite so often; we wonder which are most popular? Every morning we receive letters asking for more of this and more of that. One reader enjoys a certain feature more than any other; another reader has quite a different favourite—yet somehow we make them both happy! But we really want to know which are the favourite articles, and from the list of our regular features given below, readers are asked to choose what they consider to be the eight most popular:—

Air News; Books to Read; Competition Page; Conquest of the Air; Electricity; Engineering News; Exploring the Arctic; Famous Engineers; Famous Trains; Fireside Fun; From Our Readers; Guild Pages; In Reply; Mail Bag; Model-building Contests; Our Busy Inventors; Our Wonderful World; Puzzles Page; Railway News; Photography; Stamp Collecting; Standard Mechanisms; Story of Metals; Suggestions Section.

Entries must be written on postcards and competitors must write first the title of the feature they think will prove the general favourite, then the second favourite and so on until the list is complete. Each competitor must underline his own favourite; if it does not appear in his list, he must write it separately.

Prizes of Meccano or Hornby products to the value of £1 1s., 15/–, and 10/6 respectively will be awarded to the three competitors whose lists most nearly agree with the final order of voting and in addition there will be a number of consolation prizes value 2/6 each.

Postcards must be addressed to "Feature Voting Contest," Meccano Magazine, Binns Road, Liverpool, and sent to reach this office not later than 28th February. Overseas closing date, 31st May.

"My Hornby Layout"

The majority of our readers are railway enthusiasts and possess Hornby Train sets with some sort of a miniature railway layout, and from time to time we have received some very interesting accounts of the operation of those model railways.

There must, however, be many hundreds of other layouts, equally interesting, of which we have never heard and, therefore, we have decided to offer prizes to those readers who, in this contest, submit the most interesting descriptions of their ideal Hornby layout. Competitors need not confine themselves to the material they possess and, if their layout is small, may imagine they possess a bigger stock. But layouts must be suitable for laying down in a room not more than 12 feet square.

The tracks, arrangement of points, crossings and signals, number of trains and type should be explained and sketches, not larger than 6 inches square, may be used to assist the written description.

The competition will be divided into two sections, A for boys of 16 and over, B for those under, and prizes of Hornby goods to the value of £1-1s.-0d. and 10/6 respectively will be awarded to the two best entries in each section and in addition there will be a number of consolation prizes.

Entries should be addressed to "Hornby Layout" and sent to reach this office not later than 28th February. Overseas closing date, 31st May.

21st Drawing Contest

THE ROTOR SHIP

There is something peculiarly fascinating about the sea and all connected with it that urges those who make no pretence to possess artistic talent, to endeavour to convey to paper their impressions of big liners, dainty yachts, rolling men o'war and pitching tramps.

The rotor ship "*Barbara*" which has recently completed a successful trial trip, is described and illustrated on page 126 of this issue. It is the only type of ocean-going vessel that has not been featured as a "*M.M.*" drawing subject and, therefore, we are taking the opportunity of setting it as the subject of the 21st Drawing Contest.

Prizes of Meccano goods, or Artists' materials, to the value of 10/6 and 5/– respectively will be awarded to the best two entries in each of the usual two sections, A for those aged 16 and over, B for those under, and in addition there will be a number of consolation prizes.

Drawings must bear the name, age and address of the competitor and be sent to reach the Editor not later than 28th February. Overseas closing date, 31st May.

Home Results

Christmas Present Contest

Articles manufactured by Meccano Ltd., proved popular favourites and the final order of the voting was as follows:—Riviera Blue Train, No. 7 Outfit, Metropolitan Electric Train, Hornby Control Outfits, Bassett-Lowke 2-6-0 loco, Hornby No. 2 Pullman.

Despite the record entry no competitor succeeded in giving a completely accurate forecast. Several competitors listed the six chosen items but in a slightly different order and considerable care had to be exercised in choosing the winning entry which proved to be that of J. Diamond (Gillingham, Kent).

Hidden Proverbs

We must confess that we were agreeably surprised by this contest for we set out with the deliberate intention of making it a "teaser." Instead, our readers rose to the occasion and inundated us with correct solutions. Following our usual custom we have awarded the prizes to the entries showing the neatest or most novel presentation.

Prizes were awarded as follows:—1. G. Pepper (Dublin); 2. D. W. Leitch (Greenock); 3. H. B. Porter (Leeds). Consolation Prizes: C. A. Burton (Wandsworth); D. Cairns (Bangor, Co. Down); I. P. Duxbury (Margate); C. Ennis (Dublin); D. W. Ludlow (Bristol); G. Sageman (Highgate); B. Sandham (Preston); H. R. Storey (Scarborough).

December Puzzles

1. R. E. Milburn (Highams Park); 2. I. Hogg (Kendal); 3. A. D. Smalley (Notting Hill). Consolation Prize, C. N. Beattie (Lewes).

Home Results—continued

20th Drawing Contest

The winners names are as follows:—First prizes: Section A, G. R. Grigg (Crowborough); Section B, J. Bills (Stoke-on-Trent). Second prizes: Section A, F. Wardrope (Glasgow); Section B, H. Lane (Stokesley). Consolation Prizes: F. Alderson (Stokesley); H. Beats (Dundee); R. G. Emm (Paddington); J. R. Rowe (Eltham); R. Willett (Shoreham); K. Wilson (Rosyth).

Overseas Results

Where is Our Artist Right?

1. A. Gravener (Sydney, N.S.W.); 2. G. Thomas (Brussels); 3. A. Clear (Sydney, N.S.W.); 4. J. Treadnell (Koogan, W.A.)

17th Drawing Contest

First Prizes: Section A, E. S. Price (Geneva); Section B, N. Gallon (Paris). Second Prizes: Section A, E. Holder (Port of Spain); Section B, P. I. Cox (Victor Harbour, S.A.)

29th Photographic Contest

Series Section: First Prizes: Section A, N. Jones (Montreal); Section B, L. Stevenson (Karachi). Second Prizes: Section A, S. Simpson (Adelaide), S. M. Long (Auckland).

Most Interesting Seaside Snapshot. First Prizes: Section A, G. Clark (Melbourne); Section B, S. R. Lewis (Philadelphia); Second Prizes: Section A, H. A. Frazer (Wellington, N.Z.); Section B, T. J. Morris (Vancouver).

30th Photo Contest

First Prizes: Section A, J. S. Simpson (Sydney, N.S.W.); Section B, S. Edwards (Brisbane). Second Prizes: Section A, C. Goonting (Kuala Lumpur); Section B, F. Ward (Port Said).

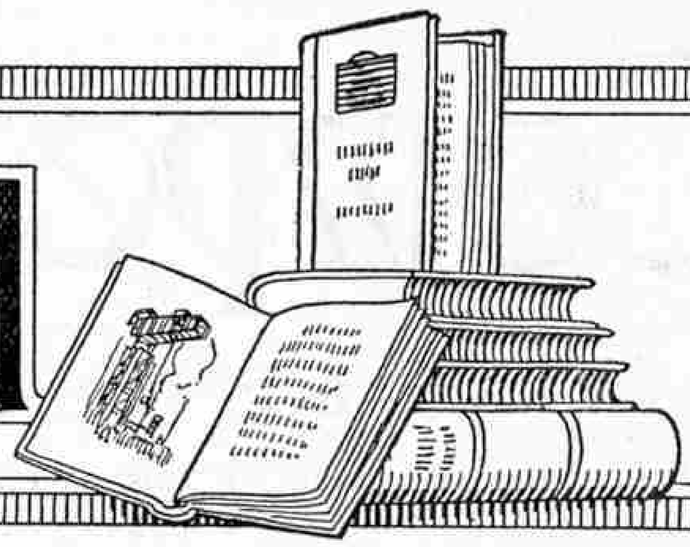
September Essay

First Prizes: Section A, T. R. Newman (Sydney, N.S.W.); Section B, L. Fisher (Johannesburg). Second Prizes: Section A, G. E. Smith (Hobart); Section B, W. S. Kaler (Otago, N.Z.)

September Doublets

1. L. O'Brien (Johannesburg); 2. A. Kuma (Delhi); 3. W. E. Broadbridge (Formosa); Consolation Prizes: M. Buring (Launceston); S. Falkof (Johannesburg); J. L. Fraser (Nelson, N.Z.); J. P. Goldfinch (Taumarunui, N.Z.); H. W. Turner (Hastings, N.Z.)

Books to Read



Readers frequently write to me asking if I can recommend books that are both of interest and of use. On these pages I review books that specially appeal to Meccano boys. I do not actually supply these books, which may be obtained either through any bookseller or direct from the publishers.—EDITOR.

"Science for All"

(Ward Lock & Co. Ltd. 6/- net)

This book covers a wide range of subjects including Astronomy, Botany, Geology, Physics, Zoology, and is illustrated with nearly 300 photographs and diagrams. Those readers who are interested in science of any kind will find it a storehouse of authoritative information, for the various sections of the book have been compiled by well-known scientists.

The volume is divided into sections, each of which deals very thoroughly with the subject concerned. In the Physics section, for instance, there are chapters on the general properties of matter, heat, light, sound and electricity. There is also some interesting information in regard to the cathode and X-rays. One of the illustrations to this section shows X-rays applied to testing paintings. In the Botanical section one of the most interesting chapters is devoted to the environment of plants. Perhaps the most fascinating section of all, however, is the final one which deals with the story of man.

As Sir Charles Sherrington truly remarks in his valuable introduction :– "To all and each come moments and seasons when thought asks more than the naïve acceptance of scenes and happenings at their face value. Among the objects of our curiosity and contemplation is Nature, meaning by that term all that we see and hear and have brought home to us by our senses and about which we have the impression that whether we ourselves exist to perceive them or no, they will exist all the same. It is at such times that we are impelled to enquire what those who have made special study of this or that aspect of Nature have to say about it." "Science for All" makes it possible to quickly learn the latest views of leading scientists, in each particular sphere of their activity.

* * * *

"Evolution"

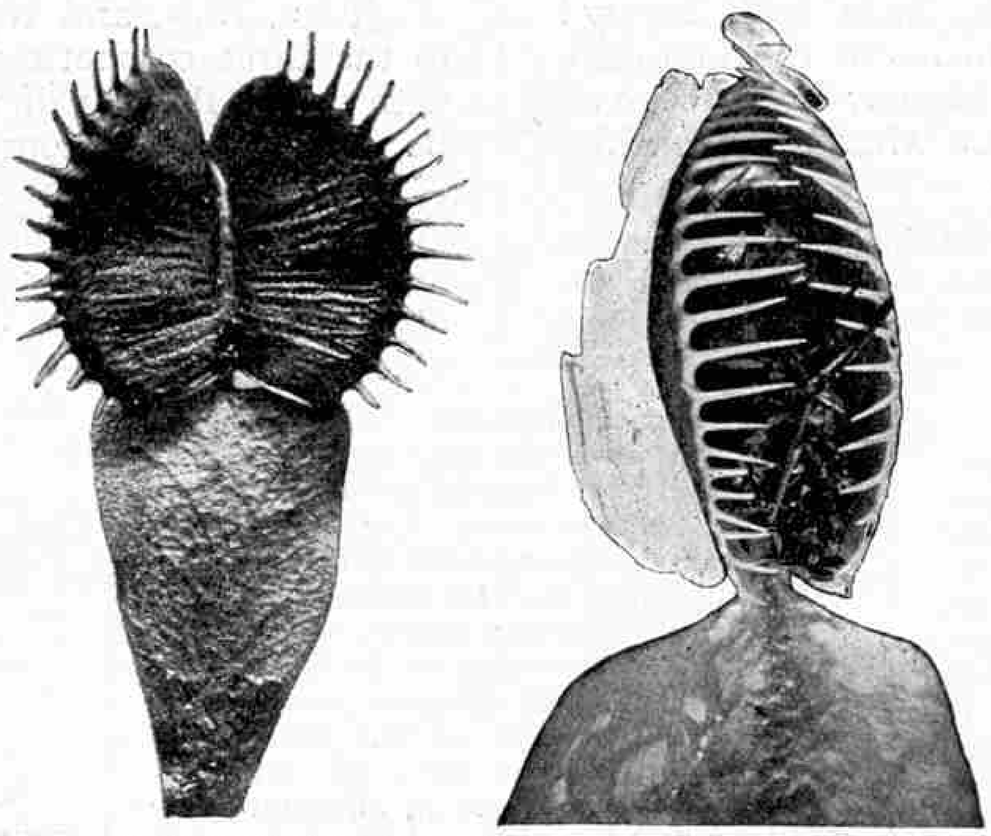
By J. Graham Kerr, F.R.S. (Macmillan & Co. 12/-)

The question whether man is descended from the monkey is no longer addressed to new boys—as once was often the case—for now-a-days the new boy is well-informed and invariably knows the answer. But nevertheless the great question of evolution holds the attention of scientists and no doubt will continue to do so as long as the world remains.

Evolution is a fascinating subject and those who wish to study it from its many aspects will find the book very useful, for it gives a good outline of the science as it is understood to-day. The author follows Charles Darwin in the matter of evolutionary theory, but adopts various modifications in detail from that of the famous scientist.

In addition to the main subject, the book deals also with the geographical distribution of animals; Inheritance; Mendelism; Communal Evolution; the Evolution of the Race; of Land Animals; of Organs; and similar important subjects.

One of the most interesting sections deals with the subject of the ability of insects and animals to adapt themselves to their surroundings, and some interesting photographs of protective mimicry and isolated markings are reproduced, particularly two fine coloured plates illustrating mimicry in butterflies.



A plant that feeds on flies—the Venus Fly Trap

On the left the trap is shown open in readiness for a victim, and on the right, the trap has closed on its victim, the teeth interlocking and preventing the fly's escape. (From "Science for All" reviewed on this page)

* * * *

"Animals of Land and Sea"

By Austin Clark. (Chapman & Hall Ltd. 15/-)

In this fine book the author not only tells the story of the animal world and shows the relationships of the various divisions to each other, but also traces the relation of the whole to the plant world, to physical conditions and to mankind. For this original method of presenting the subject, the author has collected his information from a large number of literary and other sources, so that the book forms also a useful reference work representing a large number of sources of information.

The immensity of the subject becomes evident when we learn that there are so many insects now known that if we were to recite their names, at a speed of four a minute for four hours every day, ten months would be necessary to speak the list! Similarly, nearly three months would be required to recite the names of the remaining forms of animal life.

The book, which is well illustrated, includes such interesting subjects as Animal Names; Human Foods; Man as Food for Animals; Man's Chief Competitors; Animal Flight; Largest Living Creatures; Fresh Water Animals, etc. "Living Lamps" is a chapter of particular interest and deals with luminous insects and marine life.

* * * *

"The Book of the Aeroplane"

By Capt. J. S. Pritchard
(Longmans, Green & Co. Ltd. 7/6 net)

To tell the story of the aeroplane in all its aspects in a book of some 250 pages would appear an impossible task, but Capt. Pritchard has undertaken it and succeeded to a remarkable extent.

Beginning with a short outline of the early days of aviation, the author leads us step by step to the practical accomplishments of the Wright brothers. He next explains in the simplest possible manner exactly how an aeroplane flies, and having thus given us a foundation of practical knowledge he passes on to deal with some famous flights and races and records. In subsequent chapters the various types of aeroplanes and seaplanes and the engines that drive them are described. Finally, after an account of the wonderful work already accomplished by the great airways of the world, the author discusses the question of safety in the air and the future of flying.

One of the most valuable features of this very interesting book is its illustrations, 58 in number. These obviously have been selected with the greatest care and they fit in with and amplify the text in a manner that is not too common in books of this nature.

* * * *

"A Useful Locomotive Chart"

(Locomotive Publishing Co. Ltd. 1/6)

The Locomotive Publishing Co. Ltd. have added to their well-known series of locomotive charts a very fine set of coloured drawings of an L.M.S. standard 0–6–0, class 4, superheated freight tender engine. The drawings are beautifully printed on art paper and comprise an elevation and plan of the engine, front and front sectional elevations and sectional elevations through cab and firebox.

The several illustrations are clearly numbered according to the usual practice in these charts, and references are given to 247 details of the mechanism and engine parts. We can recommend the publication to all readers who require clear and detailed information regarding the construction and operation of a modern freight loco.

"Clouds"

By C. J. P. Cave
(Cambridge University Press. 5/– net).

This interesting volume deals with clouds and weather phenomena from an unusual point of view. In contrast to the average book on meteorology, its various chapters deal in a non-technical style with the appearance of the sky under different conditions.

Starting with the colours of the sunset sky, the author passes on to describe how the different cloud forms produce the various familiar skyscapes, and draws our attention to the characteristic beauties to be seen day by day. The value of the book is very greatly increased by a series of particularly striking cloud photographs, which make quite clear the different types of formation and greatly assist the author's descriptions.

* * * *

"Troop One of the Labrador"

By Dillon Wallace. (R.T.S. 3/6 net)

Three brothers—fine Canadian boys—greet their Doctor friend as he returns to lonely Labrador, where until his advent, the boys have never seen apples or oranges, nor tasted potatoes or onions, although they have trout and salmon in abundance!

The good doctor not only brings fruit, but also half-a-dozen books explaining the Scout movement and all that it means. Forthwith "Troop One of the Labrador" is called into being, the Doctor (the only one within three hundred miles up or down the coast) acting as Scoutmaster and the three boys being the first members. Recruits are naturally few and far between in view of the fact that there are only five other boys living within a radius of fifty miles, but they also join the troop and are full of enthusiasm.

On an expedition to Fort Pelican the scouts find a fur trader lying shot in his hut, and his most valuable skin stolen. Suspicion points to an Indian well known to them all, although the boys are sure of his innocence. After seeing the injured man well on the way to recovery, a party sets out to solve the mystery of the stolen skin and the attempted murder. Hot on the trail, they are sure they have found the thief, but are thwarted, and instead nearly lose a member of the party who is lost for a night and a day in a snowstorm. How it all ends, we leave those who read the book to find out.

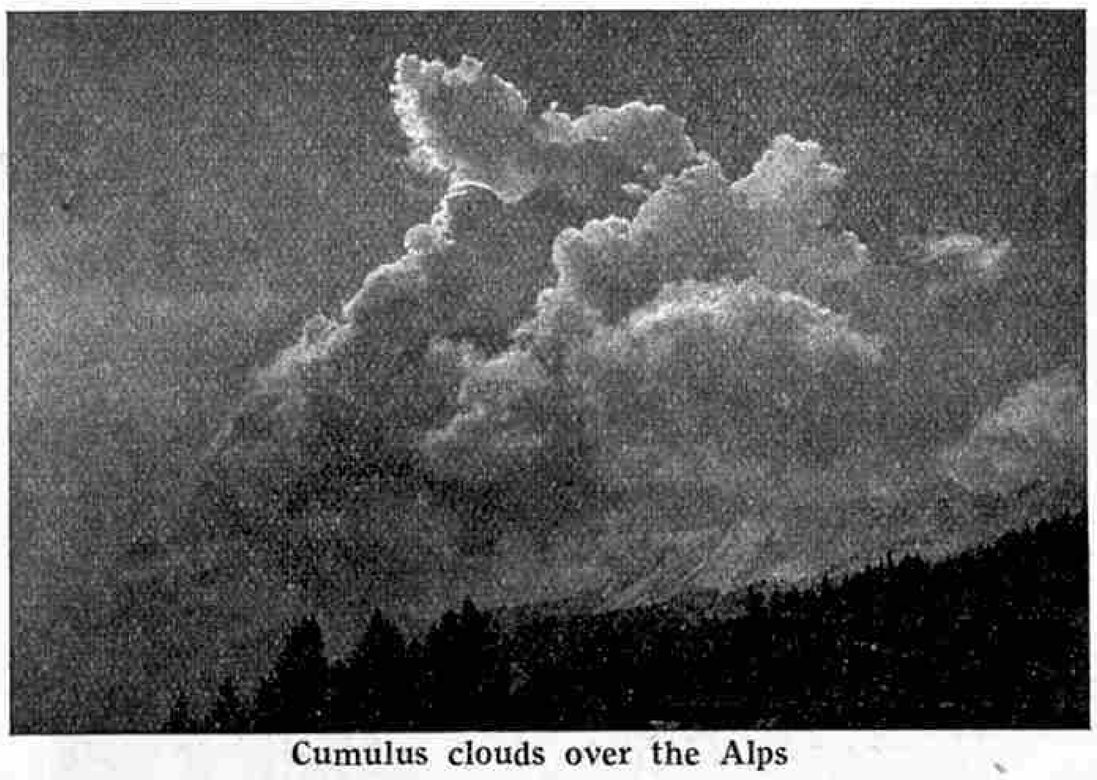
For most readers new knowledge will be found on almost every page. For instance, we learn how to make a fire in the snow; the best way to quickly build a shelter in the forest for the night; how to make bread in the open and, what is even more important, how to bake it quickly with a frying-pan! Many more things one learns from this book, but the greatest of all is, perhaps, of the good work that may be wrought in a community by a few stout-hearted boys, eager not only to learn but also to use their knowledge in helping others.

The book should appeal to all readers, and especially to those who are Scouts.

"A Sturdy Young Canadian"

By Lt. Col. F. S. Brereton. (Blackie & Son. 3/6 net)

This is an excellent story that should be an encouragement and inspiration to boys commencing their careers, more especially so if there is any possibility of their going to Canada sooner or later, for it is a portrayal of life in Canada as it actually is, without exaggerations or without the misrepresentations sometimes made.



Cumulus clouds over the Alps

The hero starts his life by working on a farm—after being left penniless on the death of his father who was swindled in the purchase of land—and whilst so employed he has an adventure with highwaymen in Calgary. His next job is as a loco fireman, and his experiences on the railroad, and the description of the powerful Canadian locomotives, will thrill the heart of all railway enthusiasts. The story of the runaway freight train, with the fireman alone on the footplate of the powerful locomotive as it dashed through the blizzard at express speed, is as exciting a yarn as the final crash is tragic.

The hero's adventures in his journey to the gold-fields make one despair of his ever reaching his destination—but it is needless to say that he ultimately does arrive! Many further adventures follow, the hero trying his hand at many things—always thinking well ahead and putting his heart and soul into all his undertakings. It is not remarkable, therefore, that through really hard work, and by using his brains, he wins through to success at last.

The book is one of cheery encouragement and is well-illustrated with drawings that have admirably caught the spirit of the story.

* * * *

"Romances of the Wild"

By H. Mortimer Batten
(Blackie & Son Ltd. 5/– net)

In this book Mr. H. Mortimer Batten, already well-known as a writer on nature subjects, tells seventeen stories of animal life, covering a diversity of creatures with whose ways he has made himself wonderfully familiar by long and patient observation.

Mr. Batten has studied the ways of animals, birds, and fish with the sympathy of a true nature student. After reading any of his stories we cannot but feel that he believes the creatures of our woods and hills have much in common with ourselves, and that to a large extent they possess similar emotions—they have their loves and their sorrows, their ambitions and their disappointments.

Anyone who is fond of outdoor life will enjoy these healthy stories, whilst to the lover of natural history they are invaluable, for the sake of the light they throw on the ways of living creatures. The stories are full of breathless thrills and adventures and make good reading for the general reader. The book is well illustrated by Warwick Reynolds, who has a considerable reputation for his drawings of wild animals.

* * * *

"Gas and Gases"

By R. M. Caven, D.Sc.
(Home University Library—
Williams & Norgate Ltd. 2/–)

This book gives an interesting and accurate account of the nature and properties of gases and in particular gives what is, for the size of the book, a surprisingly complete survey of the use of gases in industry and everyday life. It describes the manufacture of oxygen by the latest methods from liquid air and the use of hydrogen in war for filling airships; while a particularly interesting chapter deals with the burning and explosion of gases. The book is written simply and in non-technical terms and is one that should appeal to all *"M.M."* readers who are scientifically inclined.

Compact masses of Cirrus clouds
(These two illustrations are reproduced from "Clouds and Weather Phenomena" reviewed on this page)

Interesting New Books

We hope to deal with the undermentioned books in an early issue.

"The Iron Road"
by C. J. Allen (Shaw. Price 6/–)
Also published in two parts at 3/–.

"Locomotives and Their Work,"

"Railway Building,"

"Engineering Science"
by William Ward (Arnold. Price 3/–)

"The Boy Through the Ages"
by Dorothy M. Stuart
(G. Harrap & Co. Ltd. Price 7/6)

"The Romance of Our Wonderful World" *by* P. J. Risdon
(Seeley, Service & Co. Price 6/–)

FROM OUR READERS

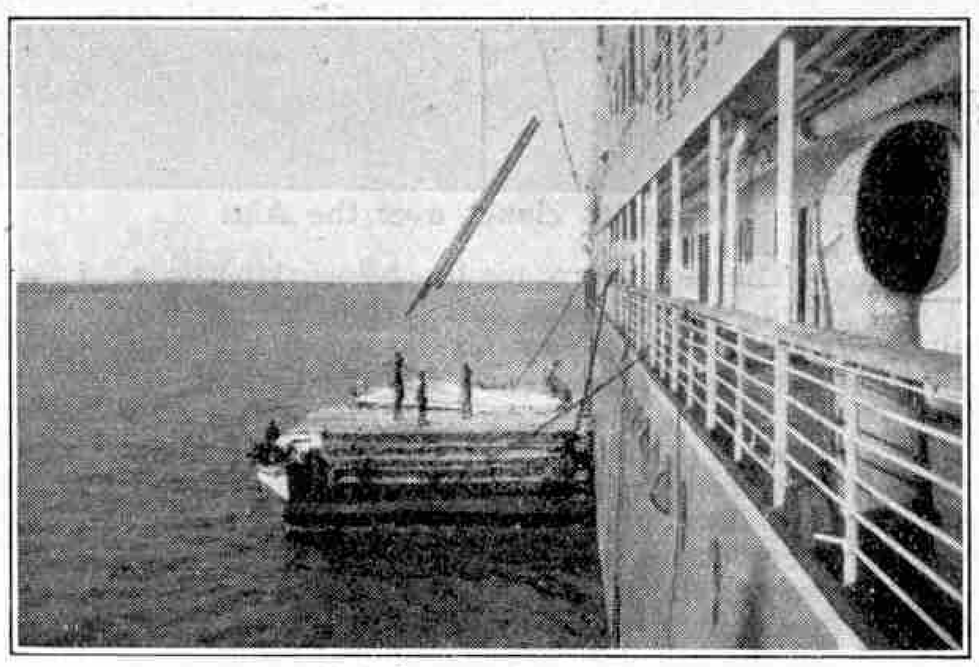
These pages are reserved for articles from our readers. Contributions not exceeding 500 words in length are invited on any subject of general interest. These should be written neatly on one side of the paper only, and they may be accompanied by photographs or sketches for use as illustrations. Articles that are published will be paid for at our usual rates. Statements contained in articles submitted for these pages are accepted as being sent in good faith, but the Editor takes no responsibility for their accuracy.

Durban to Southampton via the East African Coast

A little while ago I returned from Durban, Natal, to Southampton via the East African coast. If any of my fellow readers of the "*M.M.*" ever have occasion to visit South Africa, let me advise them to go by this route if it is at all possible. The voyage takes longer, but costs very little more than going by mail boat to Cape Town.

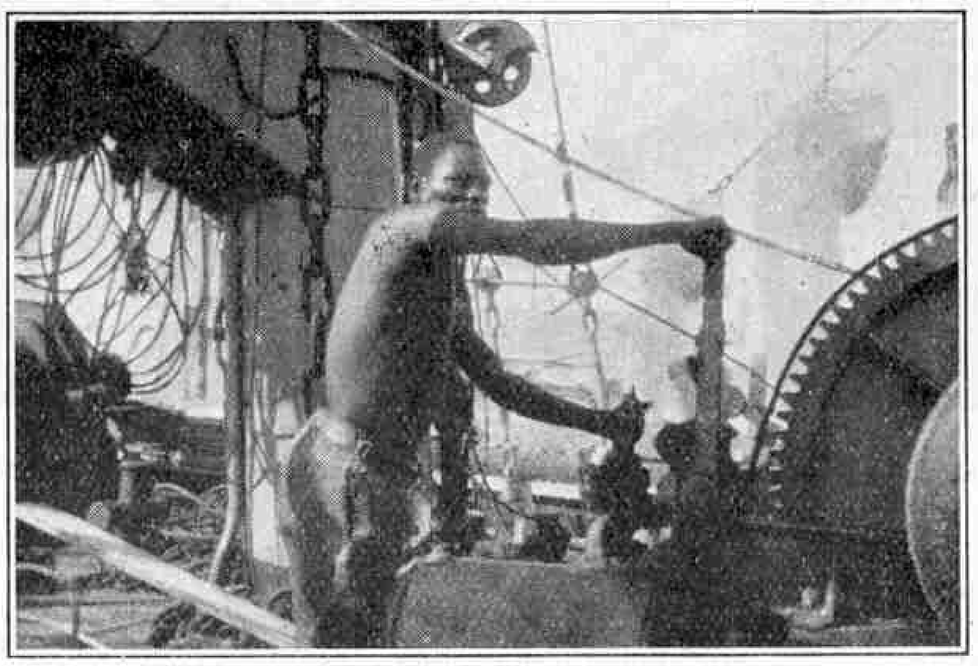
Coming up from Durban you touch, and sometimes stay for several days, at such ports as Lorenzo Marques, Beira, Mozambique, Dar-es-Salaam, Zanzibar and Mombasa, besides going through the Suez Canal, crossing the Mediterranean to Naples and Genoa and then past Gibraltar to Lisbon and home.

The accompanying photographs show the method of unloading timber, or indeed any other heavy cargo, at Beira. The name Beira means "sand," and it is very appropriate. There are no docks and therefore ships lie about half-a-mile off the town. On arrival they are boarded by gangs of natives who work under the orders of the ship's officers. They work very hard too, although the sun is blazing down and they are without the protection of a hat.



Unloading Timber at Beira

We were at Beira nearly a week and the cranes seemed to be going from early morning until midnight. Some of the natives worked in the hold where it must be fearfully hot, while others were on rafts lashed to the side of the ship. Two were on deck, the man at the windlass shown in the photograph and the foreman who regulated the movements of the timber from a position by the ship's rail. I was told that these men would work in that heat for seven hours at a stretch and, considering the weight and awkwardness of much of the cargo they handle, this appears to be a very remarkable feat of endurance.



Native working windlass on deck

There is something of interest to be seen at every port of call along this route and the photographic opportunities are practically unlimited. W. G. ADDISON (Trowbridge).

A Visit to Waalhaven Aerodrome

I and some of my friends recently had the opportunity of visiting the aerodrome at Waalhaven. We set out on a fast little steamer that carried us past the bustle and noise of the dockyards in Rotterdam Harbour, where we saw all kinds of cranes working like silent giants, loading and unloading the ships lying at anchor. Suddenly one of my friends pointed to some steel masts and said: "Waalhaven!" He proved to be right, for shortly afterwards we saw a Fokker aeroplane circle round and finally descend close to where the aerial masts rose up. A few minutes later our boat stopped at the landing stage near Waalhaven and we disembarked and entered the aerodrome.

Two huge hangars rose up on our left and our guide opened a small door in one of them. We followed him in and found ourselves in a great building brightly illuminated through its enormous glass roof. There were four light aeroplanes in the hangar and our guide drew our attention to the smallest of these, a little monoplane to carry one person. The cosy little cockpit with its important-looking dashboard simply invited one to enter and make a flight. The guide told us that this machine would become the private aeroplane of the future and that it would cost only f.7,000, approximately £583.

Leaving the hangar we paid a visit to the department where the aeroplane engines were being constructed and passed a very interesting time there under the guidance of one of the engineers. During our visit they were mounting a "*Jupiter*" engine. As every "*M.M.*" reader knows, the cylinders of this engine are placed in a circle round the crankshaft. In order to facilitate mounting the engine it is bolted to a face plate that can be rotated, and this ingenious device enables each cylinder to be reached easily.

We left this department just in time to see a Junker all-metal aeroplane landing. To our regret our visit then terminated because, unfortunately, the steamer would not wait! H. C. VAN DOORN (Utrecht, Holland).

The Cardington Airship Station

A few weeks ago I had the good fortune to visit the airship mooring mast at Cardington. On arrival I went first into the power station at the foot of the mast, where are installed the three great winches used for hauling an airship up to the cone of the mast. There is also a complete plant for pumping the necessary oil, petrol and water up to the ship.

Then I set out upon the long climb up the 300-odd steps, the lift not then being installed. On reaching the first platform, 180 ft. above ground level, I went inside the cone of the mast and up a short ladder to the second platform, 210 ft. above the ground. On this platform is a wonderful machine, weighing some 10 tons, the purpose of which is to respond to the pull of a moored ship upon the cable that holds it to the mast. The machine is free to move in all directions and thus adjust itself instantly to any changes in the pull of the ship, due to variations in the direction of the wind. The ship is held to the mast by its "nose," on which there is a fitting that is hauled by means of the cable into a cup-shaped recess at the extreme top of the mast. Around the mast at a distance of about 100 yards are ring-bolts set in concrete to which is anchored the stern cable of the ship.

The Airship Mooring Mast at Cardington

The passengers enter the ship by means of a gangway in the bow. This gangway is lowered to the top platform and fits into a circular rail running round the mast, thus enabling it to move in any direction in accordance with the movements of the ship, caused by changes in the direction of the wind.

J. R. GODDARD (Bedford).

The Grand Prix at Brooklands

On the morning of the British Grand Prix I passed through the entrance gate at Brooklands for the first time. There were very few people present when I arrived, so after an interesting look round I took up a position opposite the first hairpin bend. There was a good deal of activity all around. Racing cars were making periodical trips from the paddock to the pits and back; heated discussions on the merits of different drivers were plainly audible and everywhere the hope was being expressed that the rain would hold off. Then last-minute trips to the pits by anxious drivers indicated the approach of the start, which was timed for 2 o'clock. Eventually all the cars lined up where the finishing straight joins the main track, just beyond the members' bridge. There were three Talbots, three Delages, an Aston Martin special, a Halford special and a Bugatti.

The flag dropped and most of the cars leaped away, with Divo driving No. 1, a Talbot, in the lead. Before a lap was completed, Moriceau, driving a Talbot, broke a front axle while travelling at over 100 m.p.h., but brought his car safely to a standstill. Thus one of England's hopes was gone already. The rest of the cars screamed and thundered up to the first hairpin, skilfully negotiated it, tore up to the second, passed it in a moment and shortly afterwards were to be seen travelling along the railway straight at over 110 m.p.h. From there they mounted the banking, looking for all the world like flies skimming round an enormous bowl.

The race was a wonderful spectacle and full of incident. Unfortunately England was dogged with bad luck and no English car finished. Segrave was in difficulties with persistent engine truble and eventually had to retire. Major Halford had very bad luck in breaking his universal joint which, of course, necessitated his retirement also.

I enjoyed every minute of the race. Some long-distance races are said to become dreary but I found incident in plenty in every lap to keep me excited.

W. L. DAWSON (Gillingham).

Paper Making

A short time ago I was fortunate enough to be able to visit a paper mill. On arrival there I was taken first to the engine-house, which contained the biggest wheel I have ever seen. This monster wheel drives the whole of the machinery in the mill from a shaft that runs throughout the main building. I felt as though I could have watched the engine all day, but after a few minutes I was taken to the reception bay where were stacked bales of esparto grass—the chief factor in the making of the paper—previous to being cleaned by an electric beater.

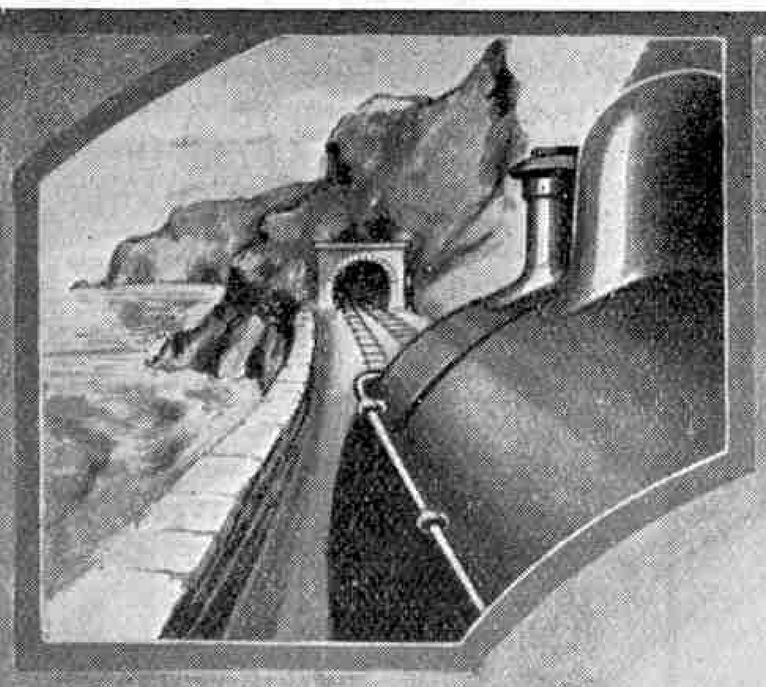
When the dirt has been removed, the grass is boiled, and I was fortunate enough to see this process in its various stages. One boiler was being emptied, another cleaned and the rest were boiling. I was glad to get out of this place, however, owing to the disagreeable smell given off by the boiled grass.

We then passed into a room where the grass was being cut up by revolving blades and wood pulp and dye were being added. Then came the cleaning room, where the mixture was shaken up to remove grit, etc., and then passed over fine wire mesh bands into a kind of truck.

In the next department were the drying and rolling machines where the paper, after being watermarked and rendered as dry as possible by suction, passed over steaming rollers. Finally I saw the huge rolls of paper being folded and cut and packed for transport.

One of the most interesting features of paper making is the remarkable difference between the raw materials and the finished product. In this mill esparto grass was the raw material and this certainly does not resemble paper in any respect. In other paper mills, however, the raw material is wood. It is strange to think that most of the newspapers we read are printed on paper made from trees that not so long ago were growing in the forests of Canada or Norway.

W. O. GALBRAITH (Newcastle-on-Tyne).



Railway News of the Month

20-Ton Trucks

Out of a total of 11,010 wagons registered in the Railway Clearing House last year as privately owned, 9,099 were for use in handling coal and coke. Only four 20-ton wagons were registered for this class of traffic, in spite of the five per cent. rebate offered by the Great Western Railway to users sending their coal in trucks of this capacity. The remaining 9,095 trucks were of 12-ton capacity.

* * * *

New Dock Locos

Six small but powerful tank locomotives of the 0–4–0 type have been constructed by the Avonside Engine Company for use on the G.W.R. docks at Swansea. The locos are specially designed to take the short radius curves on the docks. Their wheelbase is only 6 ft. 6 in. and the coupled wheels are 3 ft. 9½ in. in diameter. The boilers are of the Belpaire type, non-superheated, and have a total heating surface of 864 sq. ft. and work at a pressure of 170 lb. per sq. inch.

The locos develop a tractive effort of 19,510 lb. They are fitted with outside cylinders 16 in. diameter by 24 in. stroke, with slide valves operated by Walschaerts' gear. Steam brakes are fitted and the cabs are closed in. The total weight of each loco in working order is 38 tons 4 cwt., the capacity of the side tanks being 1,000 gallons.

* * * *

Radio on Russian Trains

The Moscow-Leningrad express on the Russian Railway has been equipped by the Soviet authorities with an experimental radio outfit, each compartment of the train being fitted with plugs for loud-speakers and headphone attachments. The aerial is slung along the roof of the train. Regular programmes are received from the Government broadcasting station and in addition to music, lectures and news bulletins, performances from the Moscow Opera House are also broadcast. If the present experiment proves popular and successful it is intended to equip other trains also.

* * * *

A new railway station is to be built for the municipality of Sao Paulo in Brazil. The building will be approximately 1,060 ft. in length, 175 ft. in width and its roof 160 ft. high. There will be six platforms each 635 ft. in length, three of which will be for goods service and the others for passenger service.

New Great Western Railway Line

The G.W.R. are proposing to apply for powers to run a branch line from Wolverhampton into the Cannock Chase coalfield where at present the L.M.S. have a complete monopoly. The new line would run from Wolverhampton through Hilton, Shareshill, Hatherton, Huntington, Hednesford through Cannock Wood to Brereton.

Difficulties Explained

3.—THE COMMUNICATION CORD

Many readers are of the opinion that the railway communication cord runs the complete length of the train and provides a direct line to both guard and driver. Such is not the case, however.

The communication cord is connected to the automatic brake and when pulled causes a partial application of the brake on the coach. The application of the brake affects the whole train and in this way the attention of the guard is attracted. At the same time that the brake is applied, a whistle on the end of the coach affected commences to blow, and a small disc drops and indicates to the train staff the particular vehicle concerned.

Remarkable "Pacific" Work on the L.N.E.R.

During the reduced train services of the past year the L.N.E.R. 4–6–2 engines have put up some wonderful performances. Time has been kept on the "*Flying Scotsman*" with loads right up to 600 tons behind the tender, instead of the normal figure of rather below 400 tons. On the up journey of the "*Scotsman*," with loads of round about 400 tons, lost time to the extent of between 10 and 12 minutes has been regained between Peterborough and King's Cross alone.

One typical feat on the down "*Scotsman*" of recent date was that of No. 4479, "*Robert The Devil*," which with 375 tons was stopped at St. Neot's by reason of a slight defect in the train, but picked up the 7 min. loss of time so entailed and 3 min. more as well, reaching Grantham 3 min. early. On another occasion No. 4477, "*Gay Crusader*," with 530 tons behind the tender, covered the 47½ miles from Stevenage to Fletton Junction in 40 min. 40 sec. at an average speed of 70 m.p.h.

The New Locomotive Numbers

Owing to the grouping of British Railways under the Railways Act of 1921 into four great companies, and the consequent process of re-numbering and re-painting, it is often difficult to recognise old favourites even on lines with which we are familiar. The following details may assist readers in identifying some of their old loco friends.

LONDON MIDLAND AND SCOTTISH RAILWAY

Passenger locos painted old Midland red; Goods locos black.

Nos. 1 to 4,999 :—Former Midland locos, including a few North Staffordshire locos.

Nos. 5,000 to 9,999 :—Former London & North Western locos, also locos belonging to Furness & Wirral Railways.

Nos. 10,000 to 13,000 :—Locos belonging to the Lancashire & Yorkshire and Yorkshire & Furness Lines.

Nos. 13,001 upward :—Scottish locos.

LONDON AND NORTH EASTERN RAILWAY

The express Passenger locos Great Northern green; Goods and Tank locos black.

Nos. 1 to 3,000 :—Late North Eastern and new standard L.N.E.R. Locos.

Nos. 3,001 to 5,000 :—Great Northern Locos.

Nos. 5,001 to 7,000 :—Great Central and former Great North of Scotland Locos.

Nos. 7,001 to 9,000 :—Great Eastern Locos.

Nos. 9,001 upward :—North British Locos.

GREAT WESTERN RAILWAY

Locos taken over from other railways are numbered with those of the late Great Western locos according to class. Colours of locos remain unchanged.

SOUTHERN RAILWAY

Locos painted green. All numbers remain the same but letters are added as follows :—

E (Eastleigh) to all London and South Western locos.

A (Ashford) to all South Eastern and Chatham locos.

B (Brighton) to all London, Brighton and South Coast locos.

K. Bindoff (Ramsgate).

* * * *

Ten Fordson motor tractors have recently been purchased by the L.N.E.R. to haul wagons in the vicinity of the sidings and warehouses at the King's Lynn quay. The work was previously performed by horses.

Elephants as Passengers

Many peculiar cargoes have been carried by the Harwich-Zeebrugge train ferry, but rarely one more miscellaneous than that of Wednesday, 8th December, which included four dancing elephants for shipment to Belgium. The elephants were not in the least perturbed, but walked quite unconcernedly from the station to the ferry. There they were safely accommodated, and promptly proceeded to give a variety "turn," to the vast amusement of the steamer's crew.

* * * *

New G.W.R. Tenders

The recently-introduced G.W.R. engine No. 5000, "*Launceston Castle*," concerning which a short note appeared in our November issue, is similar in all its main particulars to the earlier "Castle" locos, but differs in that it possesses a new type of tender that is somewhat higher than the standard G.W.R. tender, owing to the tank being placed slightly higher than the footplate. The plates forming the coal space are sloped toward the centre and front of the tender and, as the coal is thus automatically fed to the shovel, the tender is self-trimming.

The new tender is fitted with flat springs and both vacuum automatic and hand-brake installations. In the latter case the power is applied to the blocks through a compensation gear that automatically maintains an equal pressure on all blocks. The tender's weight is 46 tons 13 cwt. and it carries six tons of coal and 4,000 gallons of water. A standard equipment for picking up water is carried.

* * * *

L.N.E.R. Goods Engines

The L.N.E.R. Darlington (North Road) works have built recently some new 0–6–0 goods engines of the J.39 type. The new engines conform in all details with current L.N.E.R. practice, but a new type of cab, with side windows and an extended roof, has been introduced. Each engine has two cylinders between the frames, 20 in. diameter by 26 in. stroke; the wheels are 5 ft. 2 in. diameter and, including the superheater, there is a total heating surface of 1,644 sq. in. The tractive effort is 25,664 lb. and the total weight of engine and tender in working order is 102 tons, 1 cwt.

* * * *

First Public Time-Tables

The following old Railway order, dated 1855, is of historical interest :—

"Each station agent is herewith furnished with pieces of mill board on which the time-tables for the present month have been pasted. These boards must be immediately hung up on the platforms where they can be easily perused by the Public.

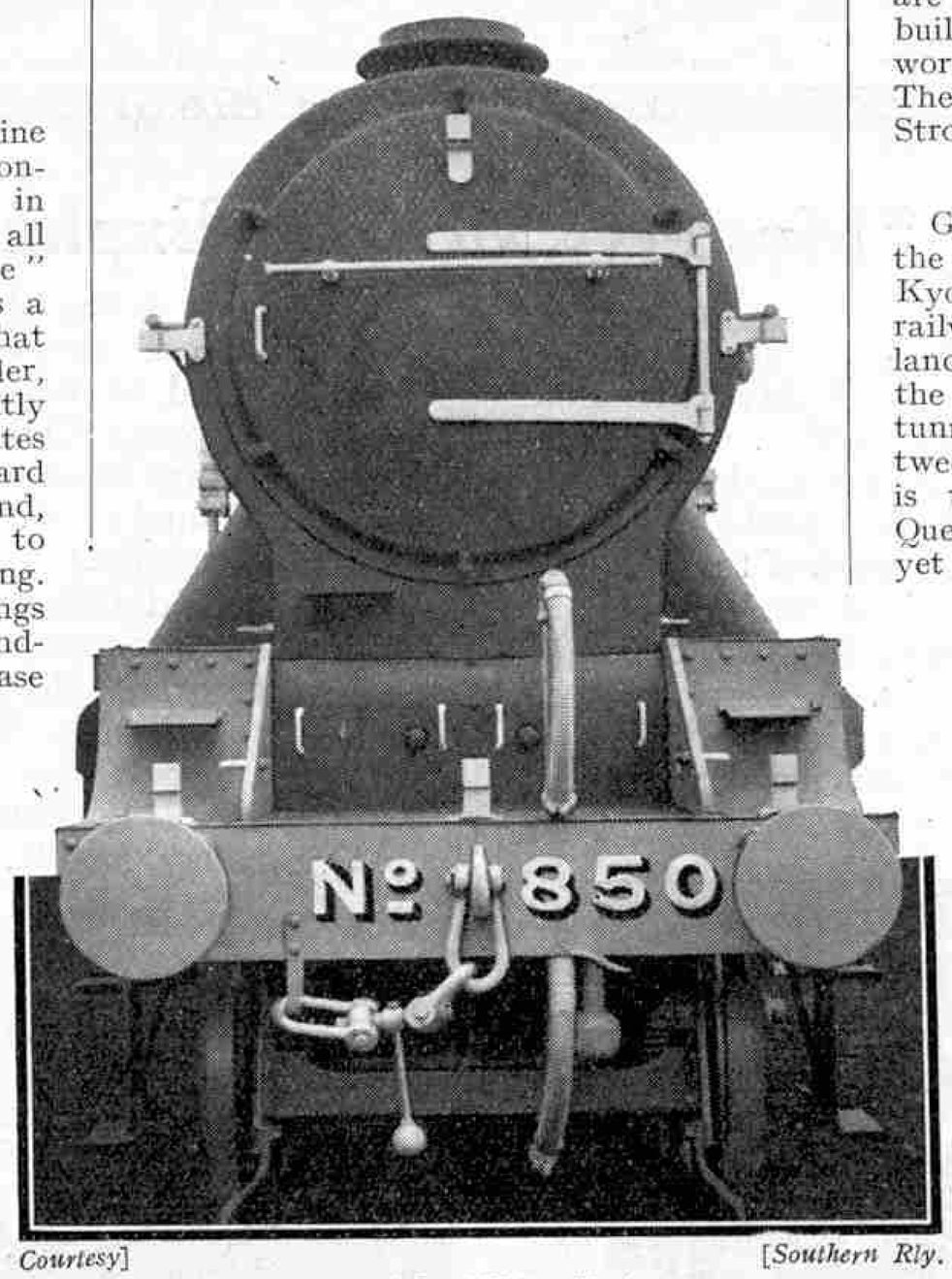
"At the commencement of every month in future, the Agents are required to cut up four copies of the Public time-tables, and paste them neatly and with great care on those boards. This must be done promptly so that passengers wishing to consult the same may have no valid ground of complaint on the score of unnecessary delay."

Signed, THOS. K. ROWBOTHAM,
General Manager.

EDINBURGH, *October* 3, 1855.

News from Glasgow

L.M.S.R.—The 10 o'clock to London has recently been worked by 14752 (old 903 "Cardean"), and this engine returns from Carlisle on the 10 o'clock from London. This is a very good turn for one engine to perform daily. The 10.10 to Manchester and Liverpool has been handled by various engines, varying in size from a Pickersgill 4–6–0, 14632, to a small Dunalastair II., No. 14333. In Buchanan-street Station recently a new Pickersgill 4–6–0, No. 14640, was noted on a goods train. Dunalastair III. 4–4–0, 14336 (Stirling), is repainted and has been fitted with a large 8-wheeled tender.



Courtesy] [*Southern Rly.*

Front view of the "Lord Nelson" (*see page* 98)

The 9.15 St. Enoch to St. Pancras had recently Deeley 1148 (fitted with G.S.W.R. whistle) and G.S.W.R. 4–4–0, No. 14376, on 270 tons (full). C.R. Pickersgill 4–4–0, No. 14466, was also seen here, as well as C.R. type new 0–4–4T. 15263 and C.R. 4–4–0T. 15021 (old No. 2).

L.N.E.R.—It is interesting to compare the climbing capabilities of 'Scotts' and 'Directors' on Cowlairs bank. Whereas 6384 "Edie Ochilstree" had taken 5-5/6 mins. on 300 tons, 9428 "Adam Woodcock" took only 5 mins. on 330 tons. The maximum unbanked load for these engines up the bank is 150 tons.

Engines recently scrapped at Cowlairs are Drummond 7 ft. 4–4–0's Nos. 593/4/7, and class 'D' 0–6–0 9580.

Recently repainted engines are 9426 "Norna," 9896 "Dandie Dinmont," 4–4–0 9766.

Recently overhauled are 2563 "William Whitelaw," Atlantics Nos. 9872/5/6/9, 9901/2/4, Directors 6389/92; Gresley 2–6–0 Nos. 32 and 188; Scotts 9339 and 9497; Glens 9034, 9291, 9493.

G.N.R. 4–4–0 No. 3052 is Westinghouse fitted and 3064 is at Cowlairs for overhaul just now.

More Veteran Locos

The note in our September issue re the Sirhowy loco working on the Alexandra Docks (Newport) has brought to light interesting details of three other old locos that are working on the harbour and the canal branch lines at Inverness and in the shunting yard at Lochgorm. These three are 0–6–0 tanks and were built in 1869, 1872 and 1874 respectively.

These certainly must be among the oldest L.M.S. locos still working, and they are the more interesting because they were built at the Highland Railway's Lochgorm works expressly for their present duties. The designer was the late Mr. William Stroudly.

* * * *

Good progress is being made with the earthworks and cuttings for the new Kyogle Railway that will link up the railways of New South Wales and Queensland. The cuttings have been made on the N.S.W. side to the point where the tunnel piercing the mountain range between Queensland and New South Wales is to be put through. Work on the Queensland side of the tunnel has not yet begun.

* * * *

Sydney's New Tube Railway

It is confidently expected by the responsible authorities that the new underground railway under construction at Sydney, N.S.W., will be opened in the very near future.

Overhead current transmission is being used and the technical installation is agreed to be the most modern of its kind. The architecture and the design of the two principal stations, St. James and Museum, meet the necessity for cool-looking surroundings that are demanded by the warm climate. The interior walls are faced with green and cream tiles, making a restful change from the bustle of the city. Accommodation for huge crowds has been arranged, particularly at the Museum station, for the platform there surpasses in length any English tube platform.

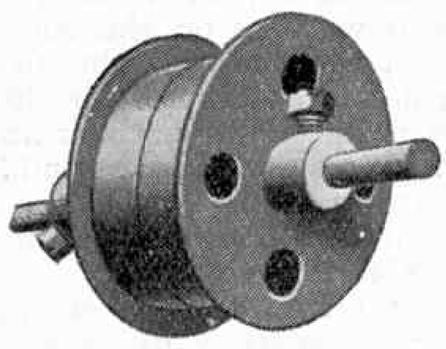
It is doubtful whether the line will be extensively used during the first year or two of its existence, but after the extension tracks have been built it is anticipated that the saving of time in travel, owing to the absence of traffic congestion, will inevitably popularise the line among suburban-dwellers.

* * * *

Red Ties Banished

A considerable proportion of the uniform staff of the Southern Railway welcomed the recent announcement that the uniform red tie was to be abolished and a blue one substituted.

The story of the adoption of the red tie is very interesting. Originally it consisted of a neckerchief, nearly a yard square, instead of the familiar simple strip of red. A director of the old L. & S.W. Railway was travelling in a train some years ago when a difficulty arose about stopping it. The idea occurred to him, and a suggestion quickly followed, that if every man engaged in traffic operations were to wear a red tie, it could quickly be removed and used as a danger signal in case of emergency. His suggestion was adopted and the red tie became part of the Company's uniform.



Meccano Belt Pulley, constructed from two Flanged Wheels

Suggestions Section

Edited by "Spanner"

The "Mystery Model" Explained

THE competition centring round the mysterious movements of the Meccano reversing gear described in the October (1926) *"M.M."* attracted a large number of very interesting entries. It is hard to imagine a more exacting test of our readers' model-building skill than that afforded by "problem" competitions of this description, and the work of the majority of the competitors cannot be praised too highly.

One side only of the model was illustrated in the October *"M.M.,"* as shown in Fig. A below, and it was explained that rotation of the Crank Handle A imparts rotary motion to the shaft carrying the wheel B. The latter shaft, however, persists in turning in a clockwise direction, no matter in which direction the Crank Handle is turned. Readers were asked to think the matter out for themselves and to describe the mechanism, or to suggest a similar method by which this curious result could be obtained.

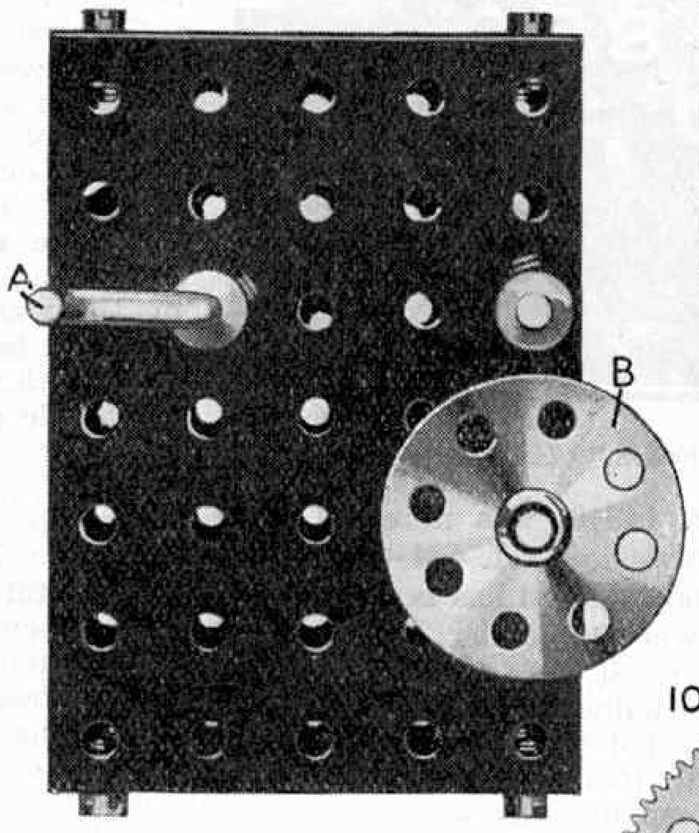


Fig. A

The Prize-Winners

As we had anticipated, the solution of the problem called for much thought and patience. Nevertheless, a large number of competitors succeeded in devising various methods by which the movement could be reproduced. Many of the entries received show really remarkable ingenuity, but only two or three resemble closely our own solution, which we believe to be the simplest possible method by which the required results can be obtained effectively.

Of these entries, those sent in by David C. Young of Sheffield, and H. A. Davies of Gwytherin, Llanrwst, North Wales, were almost identical with the correct solution, while W. F. Hughes of Barnwood, near Gloucester, and B. Dennis of Honor Oak Park, London, were very close "runners-up." We decided therefore to increase the prize originally offered and to award each of the two first-mentioned competitors Meccano products to the value of half a guinea, and each of the second two competitors with Meccano products to the value of seven shillings and sixpence.

In addition, the following competitors, who have been selected as deserving special mention, will each receive a special Certificate of Merit, together with a complimentary copy of the "Meccano Standard Mechanisms" Manual:—K. Compton, Colchester; D. H. Williams, Ipswich; John Willis, King's Heath, Birmingham; Ronald Gilbert, Finsbury Park, London, N.4; and Victor S. Smith, Dublin.

Certificates of Merit will be presented also to the following:—Francis Newman, C. F. Floyd, G. W. G. Tew, Stanley Wiggett, G. T. Earp, Raymond Stokes, E. Watson, G. Boedeker, T. N. Nesbitt, R. H. Wiegold, A. D. Smalley, and K. Helmore.

How the Model Works

Fig. B represents the reverse side of the model and the details shown therein comprise the correct solution to the mystery.

The end of the Crank Handle ("A" in Fig. A) may be seen at 3, while 9 is the driven rod carrying the Bush Wheel B. The lever 1 and Simple Bell Crank 2 are free to turn about the shaft of the Crank Handle 3, but are held in place by the Collar 4. Pivot Bolts 5 and 6 are passed through the Bell Crank and secured by the setscrews of ½" Pinions, sufficient play being allowed to permit the bolts to turn freely in their bearings. The Pinions remain constantly in mesh with a 57-teeth Gear Wheel 7 secured to the shaft 3.

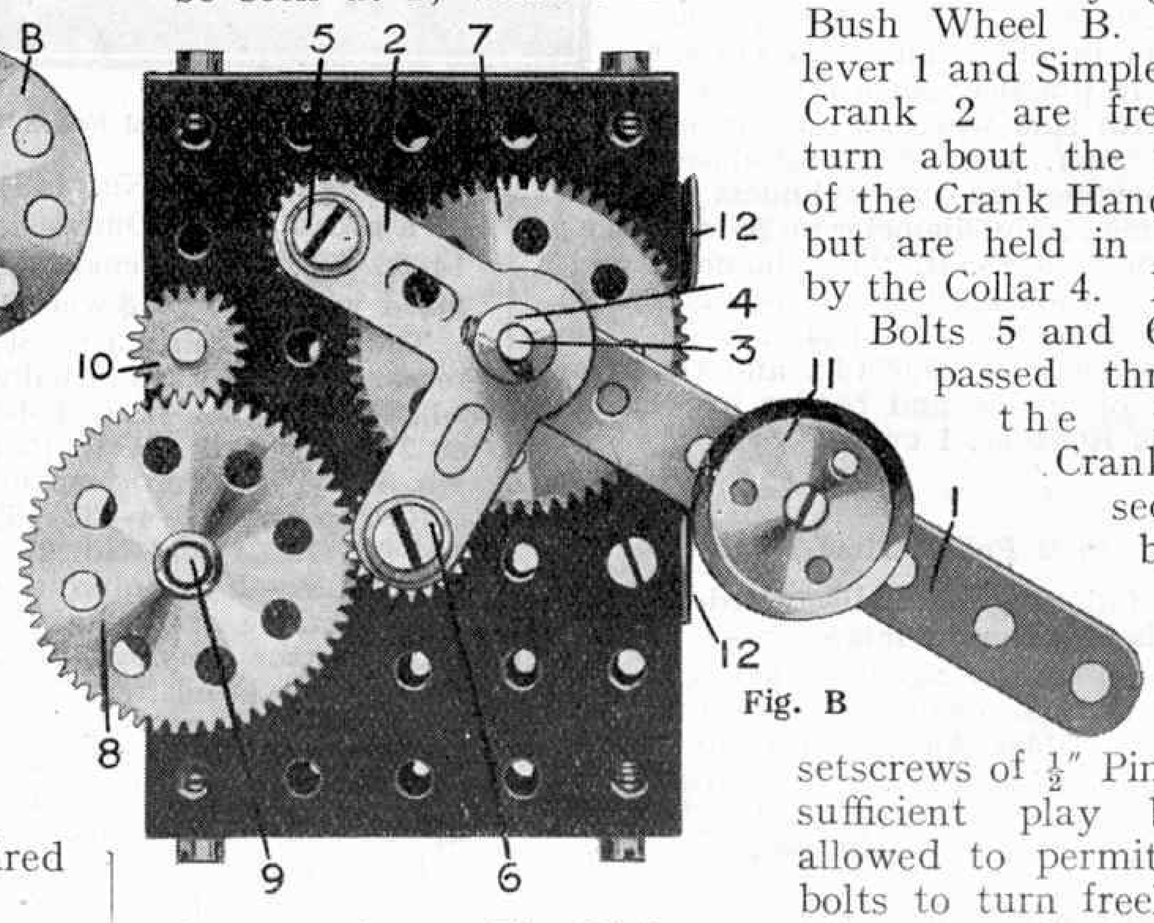


Fig. B

Let us suppose that the Crank Handle, and with it the Gear Wheel 7, is rotated in a clockwise direction, that is from left to right, when viewed as in Fig. B. Owing to the friction set up in the several bearings and between the teeth of the wheels, the ½" Pinions naturally tend to turn as one unit with the Gear Wheel, with the result that the lever 1 and Bell Crank 2 swing about the point 3 until the Pinion on bolt 6 is brought into

engagement with another 57-teeth Gear Wheel 8 mounted on the driven shaft 9. In this position of the gearing it is obvious that the shaft 9 must rotate in the same direction as the Crank Handle 3. The direction of the driving force serves to hold the Pinion in engagement so long as the shaft 3 rotates in a clockwise direction.

On the other hand, if the direction of rotation of the Crank Handle is changed the lever unit moves round in an anti-clockwise direction, throwing the lower Pinion out of gear with the wheel 8 and engaging the Pinion on bolt 5 with a further ½" Pinion 10, which is in constant engagement with the Gear Wheel 8. Thus a secondary Pinion has been inserted in the gear train, and by tracing the rotation of the various wheels it will be found that the Gear Wheel 8, and therefore the shaft 9, continues to rotate in a clockwise direction.

The 1" loose Pulley 11 is bolted to the lever to counter-balance the weight of the Crank 2 and ½" Pinion Wheels. Two 1" × ½" Angle Brackets 12 are bolted to the framework and act as stops to restrict the movement of the lever 1, so preventing the teeth of the "floating" pinions from binding with the constant-mesh gears.

Interesting Solutions

In addition to the correct entry already mentioned, H. A. Davies submitted four alternative solutions, all of which are extremely interesting. David Young's entry differs from the mechanism illustrated in Fig. B only in the substitution of a built-up bell crank unit in place of Meccano part No. 127.

B. Dennis' apparatus is based upon the correct principle and works perfectly, but he uses only one floating Pinion, which necessitates a more complicated gearing between the intermediate shaft and the driven Rod in order to prevent fouling of the teeth. W. F. Hughes employs in place of floating pinions a 50-teeth Gear Wheel, which is mounted in the end of a Crank that is capable of turning about the shaft of the Crank Handle. The operation of the model depends upon friction created by gripping the Crank between two Collars on the handle shaft in such a way that the Crank and Gear Wheel may be lifted through half a revolution when the direction of rotation is changed.

A large majority of the entries favoured the use of pawl and ratchet mechanism with which to obtain the required movement. K. W. Helmore's entry is typical of these and the principle involved will be understood from the following description of his suggested apparatus.

Pawl and Ratchet Method

Two large Pulley Wheels are free to rotate about the Crank Handle, and pivotally attached to the face of each pulley is a Meccano Pawl. The Pawls engage with separate Ratchet Wheels secured to the Crank Handle. These ratchets are opposed to each other, so that when the handle is turned in either direction one pulley revolves with it while the other is free to ride idly in the opposite direction. The pulley that is engaged by the ratchet when the Crank Handle is turned in a clockwise direction is connected by an open belt to a pulley secured on the driven shaft, while the second ratchet pulley, which can be driven only in an anti-clockwise direction, drives a second pulley on the driven shaft by means of a crossed belt (see Standard Mechanism No. 17). Hence the driven Rod rotates always in a clockwise direction.

Another method much favoured by our readers made use of a double Pawl and Ratchet movement operated by two Eccentrics. This movement will be understood if reference is made to the Meccano model Tractor (No. 712 in the Complete Manual), from the illustrations of which it will be clear that the shaft driven by the Pawls must rotate always in the same direction, irrespective of the direction of movement of the eccentric shaft.

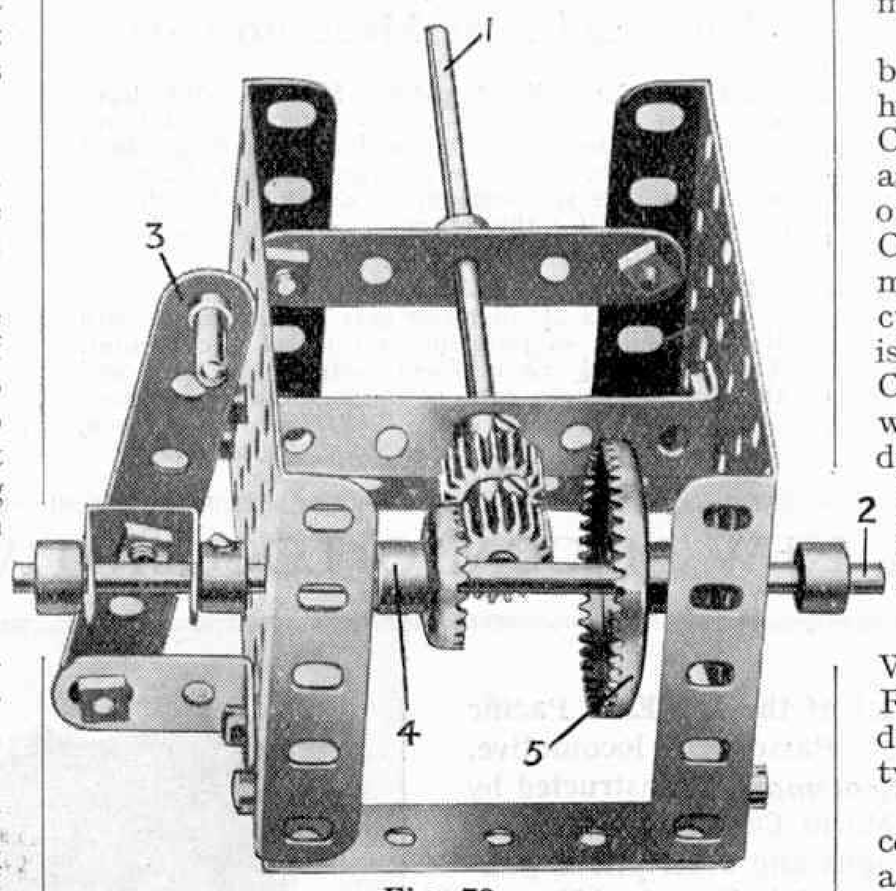


Fig. 73

Differential Gear

Mr. George Bowdler, of Kidderminster, sent in a unique and very interesting solution in which use is made of a differential gear of similar design to that used in the Meccano motor chassis (see Standard Mechanism No. 251). The Crank Handle is inserted in one side of the differential and carries one of the ¾" Contrate Wheels, while a 57-teeth Gear Wheel bolted to the differential frame (in place of the 1½" Contrate Wheel shown in S.M. 251) is controlled by a Pawl. The latter allows the differential unit to move in a clockwise direction only; hence if the Crank Handle is turned anticlockwise, the differential frame is locked in position and the motion is reversed by means of the Pinions and Contrate Wheels.

We wish to repeat that this "mystery model" was prompted by a suggestion for a new Meccano reversing gear received from Harold Dunhill, of New Southgate, to whom we have already accorded our thanks. We should be glad to receive further suggestions for similar competitions; the senders of any ideas that we are able to adopt will be rewarded.

We also wish to mention that while this competition was in progress we received a suggestion for a similar reversing gear from G. Bellairs, of Sydenham, London, S.E.26. This contributor will receive a special Certificate of Merit and a copy of "Meccano Standard Mechanisms" in recognition of the merit shown in his work.

This Month's Awards

Charles Blackburn and G. Baillie will each be presented with 5/– and a Certificate of Merit for Suggestion No. 73, and J. Morris and D. J. Davis will each receive 2/6 and a Certificate for their work in connection with No. 74.

(73)—Two-Speed Reversing Gear

(Charles Blackburn, Hetton-le-hole, and G. Baillie, Glasgow)

We have received from each of the above two readers a suggestion for a simple but very efficient reversing or change-speed gear of the type shown in Fig. 73. The mechanism is designed to give a slow forward speed and rapid reverse, or vice versa, and either Rod 1 or Rod 2 may be used as the driving shaft.

The Rod 2 is capable of sliding in its bearings and is controlled by a suitable hand lever 3. This Rod carries two Contrate Wheels 4 and 5, which are ¾" and 1½" in diameter respectively, and on operation of the lever 3, one of these Contrate Wheels is brought into engagement with one of the two ½" Pinions secured to the Rod 1. Hence if the Rod 2 is used as the driving shaft and the large Contrate Wheel 5 is thrown into gear with its respective Pinion, the Rod 1 is driven nearly three times as fast as the Rod 2. (As stated in Section 1 of "Meccano Standard Mechanisms," the gear ratio between a ½" Pinion and 1½" Contrate Wheel is approximately 2⅔ : 1).

Alternatively, if the small Contrate Wheel 4 is thrown into engagement, the Rod 1 revolves only a little faster than the driving Rod, the approximate ratio between the two being 1⅓ : 1.

If the sliding Rod 2 is required to remain constantly in gear with toothed wheels on a further driving rod, the necessary adjustment may be obtained by placing two Pinions end to end on the Rod 2, making sure that their teeth coincide exactly. The Pinions act as a single toothed unit that may be engaged by a Gear Wheel on the further shaft, and the extra width of teeth on the Rod 2 allows for the required longitudinal sliding movement.

A similar suggestion for a speed-changing device secures a Certificate of Merit for J. Petrie, of Rock Ferry.

(74)—Meccano Tweezers

(J. Morris, Chateau d'Oex, Switzerland, and D. J. Davis, Bedford)

The Meccano tweezers illustrated in Fig. 74 are extremely simple to construct, and they may be adapted to a number of very useful purposes. Stamp collectors, for example, will find that they form an implement with which valuable specimens may be handled with proper care, while photographers will find the tweezers useful in removing prints from one dish to another. In addition, Meccano boys can put them to very practical use in model-building, for it will frequently be found that with their aid a nut can be held in positions that are out of reach of even the most nimble fingers!

As will be seen, the tweezers consist of

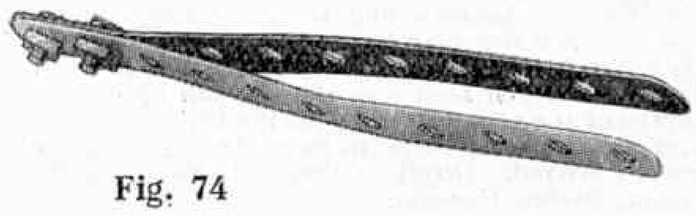


Fig. 74

two 5½" Perforated Strips bolted together very rigidly at one end and slightly bent towards the other. The "springiness" of the Strips causes the tweezers to remain open until pressure is applied by the hand.

In Reply

In these columns we reply to suggestions regarding improvements or additions to the Meccano and Hornby Train systems. We receive many hundreds of such suggestions every week, and consequently we are able to publish only ideas that show particular interest or ingenuity. Every idea, however, whether acknowledged in these columns or not, is carefully examined and considered. Practical suggestions that prove to be in popular demand are marked down for adoption at the first available opportunity. It would be of great assistance if readers, when submitting suggestions for consideration, would write them on separate sheets of paper and include their name and address on each sheet used.

Suggested Meccano Improvements

REGULATOR FOR ELECTRIC MOTORS.—The Resistance Controller included in the Hornby Series and intended for use in connection with the No. 2 Metropolitan Train and the No. 1 Riviera "Blue" Train has also been specially designed for use as a means of regulating the speed of the Meccano Electric Motor. The distance between the two holes in each side of the base of the Controller will be found to coincide with the Meccano Standard measurements, and the device may therefore be incorporated in Meccano models. The price of the Resistance Controller is 3/6. (*Reply to J. P. Smith and J. P. Wood, Wellingborough, and D. Yates, Northampton*).

BENDING MECCANO STRIPS.—Your suggested method for bending Meccano Strips to semicircular form, i.e., by placing an Axle Rod a little way through each end hole and drawing the Rods together, is most interesting and should prove to be a valuable hint for model builders. We find that it is particularly efficient in bending the smaller Strips up to 5½" in length. We are gratified to learn that you hold such a high opinion of the "*M.M.*," and trust that you will continue to discover in future issues all those qualities you admire so much. (*Reply to C. Crocker, London, S.E.*5).

MECCANO WRITING PADS.—We shall consider your suggestion regarding the addition of faintly ruled lines in the note-paper supplied in the Meccano Writing Pads. (*Reply to W. E. Cheary, Forestville, S. Australia*).

REPRINTS OF "M.M." COVERS.—Your proposal re the supply of an extra copy of the coloured cover in every "*M.M.*" would no doubt appeal to many readers, but we regret that the extra cost would be too great. (*Reply to C. Crocker, London, S.E.*5).

MODEL-BUILDING ARTICLES.—It is our aim to devote every month as much space as possible to model-building articles, and we think you will find improvements in this direction in recent issues of the "*M.M.*" (*Reply to K. F. G. Gardner, Northampton*).

ALTERATION IN MANUAL.—We must confess that we are in full agreement with your objection to the phrase printed at the end of each Outfit section in the Meccano Manuals and reading "this completes the models which may be made with Outfit No. —." As every Meccano boy knows, the models illustrated in any particular section of the Manuals by no means represent the complete range of the Outfit concerned, and we are taking steps to have the offending paragraphs altered. (*Reply to Ernest A. Rawlings, Westmount, Quebec, Canada*).

CERTIFICATES FOR PRIZE-WINNERS.—Thank you for your suggestion concerning the supply of special Meccano Certificates to be awarded in addition to cash amounts to competitors who succeed in obtaining money prizes in the model-building competitions. This would certainly provide a more permanent mark of their success and we shall consider your proposal carefully. (*Reply to Charles Sturdee, Westmount, Quebec*).

Suggested New Meccano Parts

IMPROVED SINGLE BENT STRIPS.—We have noted for further consideration your suggestion regarding an alteration in the width of the Single Bent Strip (Part No. 102) to permit the insertion of a wheel with boss. As you remark, the Crank Bent Strip has been designed for this purpose. (*Reply to J. Banks, Gillingham*).

2½" GEAR WHEELS.—We shall consider your suggestion for a 2½" diameter gear wheel to mesh with the ½" Pinion, so providing a ratio of one in four. The existing 3½" Gear Wheel contains 133 teeth and therefore provides a ratio of one in seven when geared with the ½" Pinion (19 teeth). (*Reply to F. Ferguson, Partick, Glasgow; and R. Malcolm, Harwich*).

NEW WORM WHEEL.—We regret we are unable to adopt your suggestion regarding the introduction of a Worm of larger pitch, as this would entail the addition of a complete set of new gear wheels to use in connection with it. The present pitch of the Worm is standardised, of course, with all other Meccano toothed wheels. In the motor chassis steering gear we suggest that you should employ a ½" Pinion and 1½" Contrate Wheel to transmit the motion of the steering wheel to the road wheels, as the reduction ratio in the Worm transmission is too great. (*Reply to F. Ferguson, Partick, Glasgow*).

WHEEL DISC.—We shall consider your suggestion regarding a steel disc, but we doubt whether its range of utility will be sufficient to warrant its introduction. (*Reply to J. Bryant, Brislington, Bristol*).

T-COUPLING AND DOUBLE COLLAR.—We are unable to discover any functions your proposed parts might fulfil that are not already covered by existing pieces. (*Reply to Joseph Laidlaw, Glasgow, N.W.*)

CURVED GIRDERS AND CURVED RACK STRIPS.—See our remarks regarding these suggestions in the "*M.M.*" for September and December 1926 respectively. (*Reply to Stephen Hobday, Albert Bridge, Windsor*).

FRICTION CLUTCH.—We doubt whether it is possible to add this part to the Meccano system, but we hope to have something to say about clutches of various types in an early issue of the Magazine. (*Reply to K. F. G. Gardner, Northampton*).

IMPROVED SCREWDRIVERS.—We agree that an occasional scratched finger might be avoided if a screwdriver was introduced with rounded edges, but if you will test an old screwdriver, the corners of which are worn a little, you will understand the impossibility of carrying out your idea. (*Reply to G. H. Wallis, Hull*).

DOUBLE-ARM CRANK.—We are interested in your suggestion regarding the introduction of a 1½" Strip with boss and set-screw riveted to its centre, the complete unit resembling the existing Fork Piece with the sides straightened out. We agree that this part would prove useful as a double-arm crank or as a reinforced bearing, and your proposal is undergoing a more detailed investigation. (*Reply to C. K. Kernahan, Belfast*).

COVERED CROWN CAM.—The particular type of cam that you describe would be adaptable to very few models. When it is required to impart a regular or intermittent rocking movement to a crank by means of a rotating shaft, the necessary intermediate mechanism can usually be devised from existing parts. See Standard Mechanism Nos. 264 and 266. (*Reply to V. Thompson, Woodhall Spa, Lincoln*).

RATCHET SCREWDRIVER.—The manufacture of ratchet-controlled screwdrivers and spanners would prove too expensive to permit of their inclusion in the Meccano system. (*Reply to Alfred Taylor, Shifnal*).

THREE-SIDED BRACKETS.—The new type of bracket that you propose would prove difficult to standardise with the existing system. Moreover, all its functions are already covered, apparently, by existing parts. (*Reply to Geoffrey Maddison, London, N.*16).

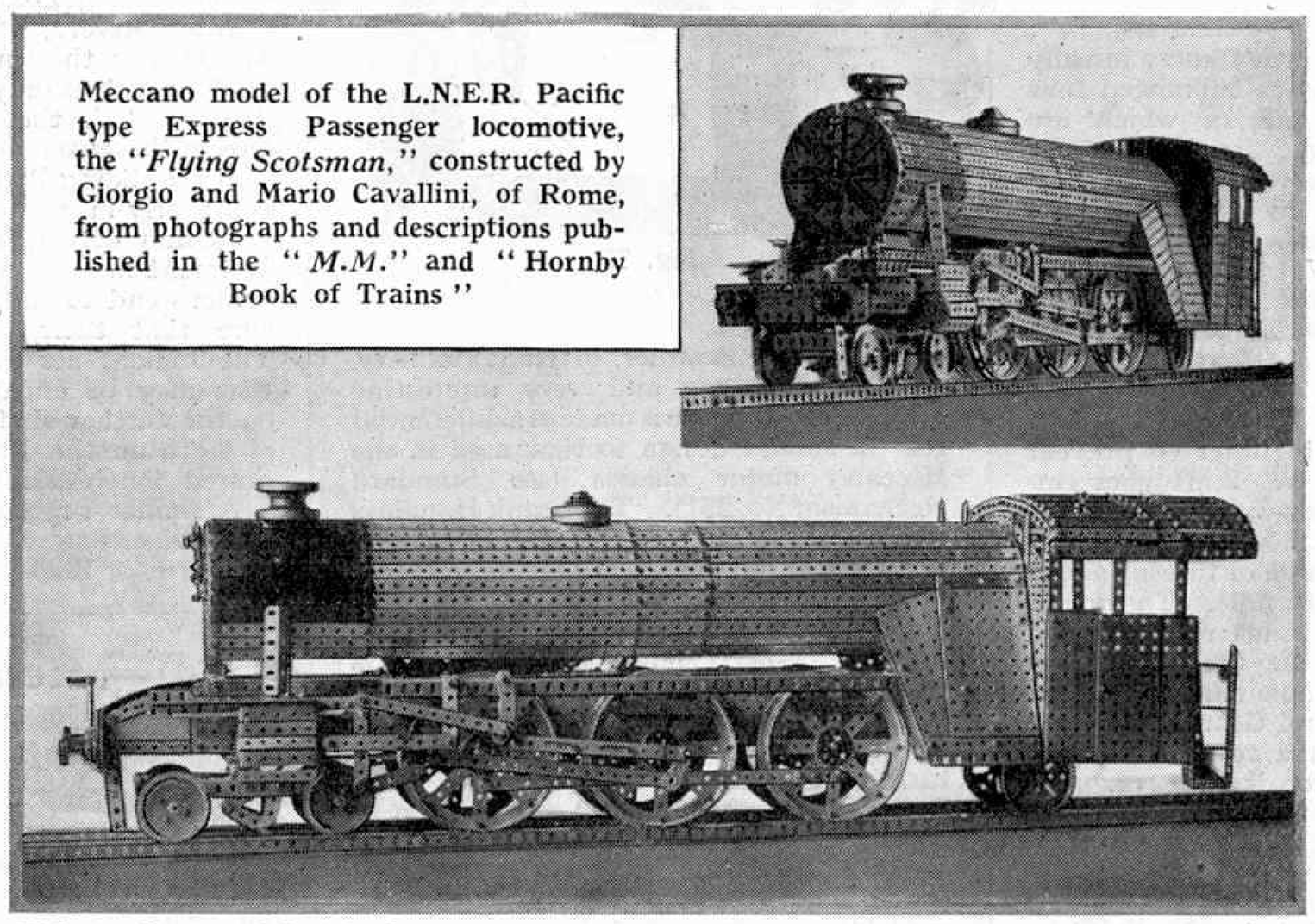
BELT MECHANISM.—We regret we are unable to adopt your suggestion. See our remarks under "Driving Belts" in the December "*M.M.*" (*Reply to S. H. Bell, Bournemouth*).

ONE-SIDED TOOTHED WHEEL.—The adaptability of your proposed special gear wheel having teeth cut in a section only of its circumference is not sufficient to warrant its addition as a new Meccano part. (*Reply to S. H. Bell, Bournemouth*).

SPIRAL WHEELS.—The particular type of wheel to which you allude is not clearly understood. Are not its functions already covered by the existing Worm. (Part No. 32)? (*Reply to George Waters, Derby*).

A NEW MECCANO LOCOMOTIVE

Meccano model of the L.N.E.R. Pacific type Express Passenger locomotive, the "*Flying Scotsman*," constructed by Giorgio and Mario Cavallini, of Rome, from photographs and descriptions published in the "*M.M.*" and "Hornby Book of Trains"



This excellent model of the famous "*Flying Scotsman*" possesses several interesting features, and we consider that its construction is especially meritorious in view of the fact that in all probability our Italian readers have never seen its prototype, or even any loco resembling it. The model is fitted with Walschaerts' valve gear, the mechanism of which is constructed in a similar manner to that described under "Standard Mechanism" No. 277. The overall length of the loco is 3 ft. 6 ins., and the extreme height is slightly over 1 ft. The inset shows another view of the model, and illustrates several interesting constructional details

Suggested Hornby Train Improvements

SPRING BUFFERS FOR LOCOS.—The provision of spring buffers on Hornby Locos would be a difficult and costly matter and offers little practical advantage. (*Reply to M. Manson, Exmouth*).

ELECTRIC CROSSOVERS.—We are paying close attention to the possibility of introducing a Hornby Crossover equipped with third rail for use in electrical layouts. (*Reply to C. J. Draffery, Musselburgh*).

AUTOMATIC LEVEL CROSSING.—We are at present experimenting with a new type of level crossing that may be opened automatically. (*Reply to H. A. Trim, Guildford*).

GARRATT LOCO.—As pointed out in the "*M.M.*" for May 1926, this type of loco would prove very costly to manufacture, and we do not consider that it would equal in popularity the more common types of engines. (*Reply to T. Dunphy, London, S.W.*19)

ELECTRIC LIVE RAILS.—We shall give further consideration to your proposal regarding the introduction of detachable electric "live" rails with which to convert the ordinary Hornby track to electrical working. (*Reply to N. G. Morrish, London, S.E.*23; *H. O. Evans, Bath*; *and S. Edwards, Welling*).

"GAUGE 00" RAILWAY.—We do not contemplate the introduction of a gauge "00" miniature railway, as there is little demand for model railways built to this scale. (*Reply to E. Winn, London, S.E.*5).

"GAUGE" TRUCK.—We cannot adopt your suggestion regarding a special vehicle for testing the track by means of the method described, as this would not be in accordance with actual railway practice. The gauge of the rails may be tested by running the head of a Hornby loco key between the lines. It will be found that the top of the key is specially shaped to conform with gauge "0." (*Reply to George Kadford, Armadale, Melbourne, Australia*).

LEVEL-CROSSING IMPROVEMENT.—It would be a somewhat difficult matter to connect up the Level-Crossing for operation by a wheel mounted in a Signal Cabin. We think that Meccano boys might be able to fix something in this connection with the help of Meccano parts. (*Reply to Philip and Leo Eaude, Dumfries, Scotland*).

THREE-WAY POINT.—See our reply on this subject in the September 1926 "*M.M.*" (*Reply to O. P. Dinnick, London, W.*)

however, and we do not think that their replicas in miniature would be popular. (*Reply to Gerald Trobridge, Johannesburg*).

SPECIAL STATIONS.—A station is very seldom placed upon a curve in the layout and it would not be worth our while to design one specially for this purpose. It is a simple matter to insert two or three straight rails in the track at the point where it is required to introduce the station. (*Reply to Derek Peel, Norbury, S.W.*16).

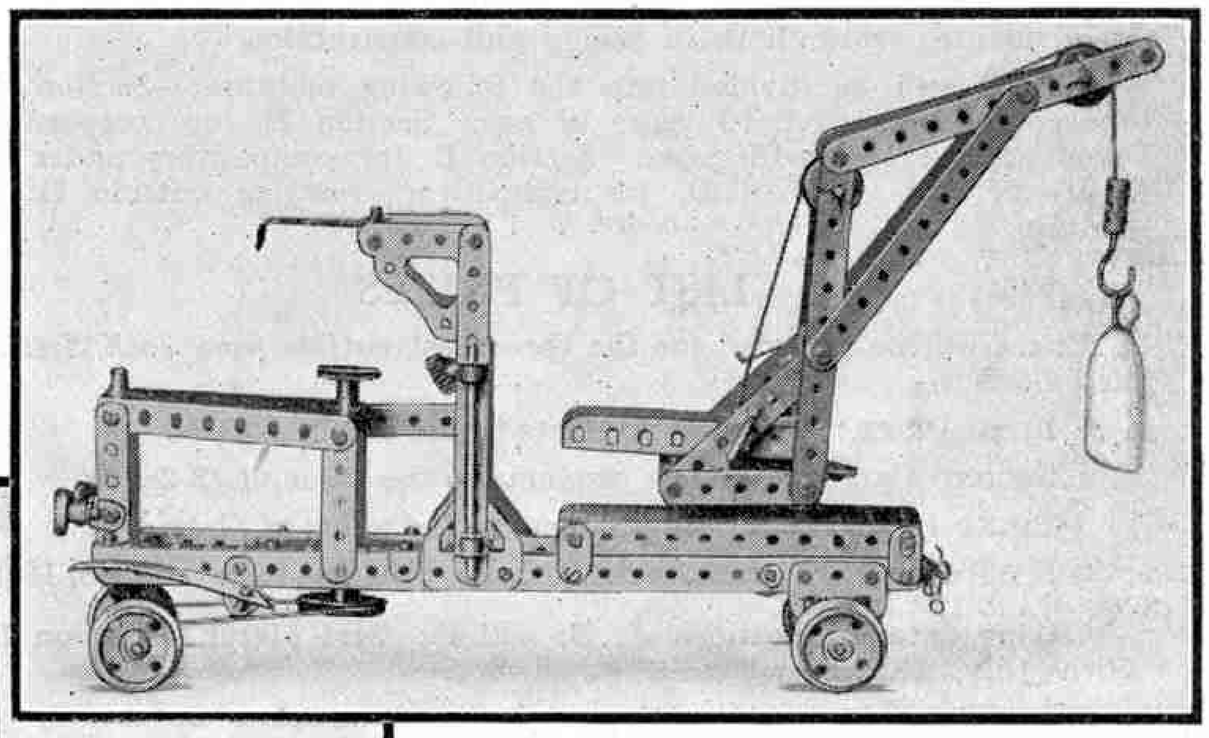
INCLINED RAIL.—We doubt whether there would be much use for your proposed inclined-rail accessory. When it is desired to embody an incline in a Hornby layout it is quite simple to bolster up some of the rails on wooden supports having a gradually increasing height. (*Reply to W. Shipsey, Olley*).

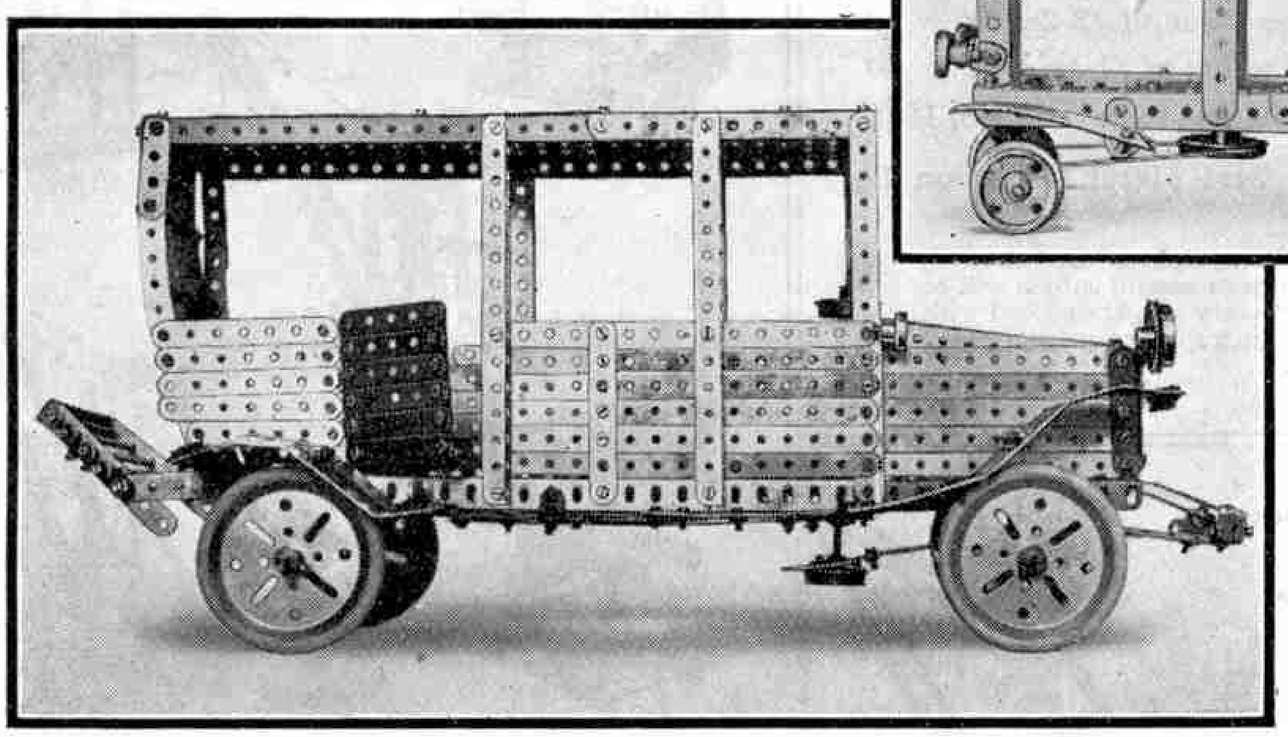
WHITE LINES ON GOODS WAGONS.—We do not consider that much advantage would be obtained by adding to certain L.M.S. goods wagons a diagonal white line, the object of which, as explained in the "*M.M.*" for November 1926, is to distinguish specially-constructed wagons, or vehicles designed for specific traffics. (*Reply to J. Archer, Poulton-le-Fylde*).

TWO PRIZE-WINNING MODELS IN THE NEW ZEALAND COMPETITION

(*See pages* 168-9)

The Travelling Swivel Crane, or Breakdown Motor Lorry, shown in the right-hand illustration was constructed by Tony MacLachlan (aged 12), of Dunedin, and secured for that competitor a prize in the 1926 New Zealand Model-building Contest. It will be observed that the motor lorry is complete with horn, head-lights, spot-light, mudguards (composed of Propeller Blades), steering-gear, and other fittings. The crane unit is mounted on swivel bearings and may be rotated by a hand-wheel secured to a shaft journalled transversely in the chassis framework.





The illustration on the left shows a model limousine car with which Nathaniel E. Hodson, of Wellington, N.Z., secured a prize in Section 3 of this competition. Master Hodson is only 9 years of age and secured fifth place in his Section. The car is mounted on laminated springs and is equipped with steering-gear, luggage grid, and lamps, etc., and it is evident that considerable time and patience must have been spent on the construction of the body-work. The doors are mounted by means of Meccano Hinges and may be opened.

NAMES ON STATION LAMPS.—We shall consider your suggestion regarding the addition of the name "Windsor" to the lamps on the Hornby Single and Double Lamp Standards. (*Reply to Mervyn Voake, Fishponds, Bristol*).

12-WHEELED LUGGAGE VAN.—Your suggested luggage van with twelve wheels, for use with the Hornby Electric Trains, would prove unsuitable for gauge "0" curves. (*Reply to W. E. Cheary, Forestville, S. Australia*).

WIDER CROSSINGS.—We do not consider that an alteration to the width of the Level Crossings would constitute any great improvement; such an alteration would merely add to their cost. The present size is designed more or less to scale with the other Hornby Accessories. (*Reply to W. E. Cheary, Forestville, S. Australia*).

INDICATOR PLATES FOR LOCOS.—There is little demand for miniature reproductions of the train-indicator plates that are employed in actual practice during the daylight hours in place of the train-indicating lamps. (*Reply to A. Goodman, Croydon*).

MINIATURE LOGS FOR LUMBER WAGONS.—The addition of miniature logs to the No. 1 Lumber Wagon is scarcely necessary, as such accessories can very easily be manufactured at home. (*Reply to Norman Newcombe, Leicester*).

LOCO SPEED CONTROLLER.—We fear that the heavy additional cost that would be incurred by the addition of speed governors to Hornby Clockwork Locos would more than counterbalance the advantages to be obtained. (*Reply to K. F. G. Gardner, Northampton*).

REAR LIGHT FOR ELECTRIC TRAINS.—We are interested in your idea for an improvised rear light, and other readers may care to adopt the simple expedient of drilling a small hole in the end of the last coach of the Hornby Electric Train to enable the lights inside the coach to be seen from the rear of the train. (*Reply to O. P. Dinnick, London, W.*)

ENGINE SHEDS.—See our replies under this heading in the August 1926 "*M.M.*" (*Reply to Philip and Leo Eaude, Dumfries, Scotland*; *W. E. Cheary, Forestville, S. Australia*; *and S. Ellins, Kensworth, Dunstable*).

TRAIN BRAKES.—The advantages to be gained by fitting brakes in the Guards' and Brake Vans are not sufficient to warrant the great increase in cost that the additions would necessitate. (*Reply to Hugh McCallum, Greenock*).

MENAGERIE TRUCK.—We note your suggestion regarding a menagerie truck fitted with bars and collapsible sides and equipped with toy animals. Such vehicles are very uncommon in actual practice,

LARGER RADIUS RAILS.—We shall pay further attention to your proposal concerning the introduction of curved rails having a radius of 2 ft. 6 ins., with which to build up a more symmetrical parallel track. (*Reply to David B. Smith, Hipswell, Yorks.*)

LIGHTING THE STATIONS.—The addition of electric lights to the Hornby Station would increase its cost considerably. If it is desired to illuminate the station it is a simple matter to fix up small electric bulbs by means of Meccano lamp brackets, etc., while the platforms may be lit by the existing Lamp Standards. (*Reply to M. S. Stancliffe, Hove, and James Pye, Swinton, Manchester*).

LANDSCAPE SCENERY.—It is a very difficult matter to design miniature trees and other pieces of scenery so that they may be adapted to any type of layout. Model railway enthusiasts usually prefer to devise for themselves scenery that is most suitable for their particular layouts, and some realistic and pleasing effects can be obtained in this way if a little trouble is taken in arranging the various items. (*Reply to Alan Duthie, Carlisle, and Frank Mills, Farnworth*).

HORNBY ANNUAL.—We consider that your suggestion for a Hornby Annual, dealing with the history of railways and other interesting matters, is already covered by the "Hornby Book of Trains." (*Reply to Edward Vivian, Parkstone*).

A New "No. 1 Outfit"

Model-Building Competition

Continuing the series of "Outfit" Competitions commenced last month, we announce below a splendid new contest in which readers are invited to submit models built entirely from Outfit No. 1.

HOW TO ENTER

Prizes will be awarded for the models that the judges decide to be the best received, after due consideration has been given to the originality of thought and constructive skill displayed in every entry. Models possessing points of exceptional interest will be described in the Magazine and if suitable they will also be included in forthcoming Instruction Manuals.

An interesting feature of the contest lies in the fact that all competitors will have at their disposal an equal number of parts. Any type of model may be submitted provided that it is the competitor's own unaided work, both in design and construction.

Entries will be divided into the following sections:—Section A, for competitors over 16 years of age. Section B, for competitors over 12 and under 16 years. Section C, for competitors under 12 years of age. Section D, for competitors residing outside Great Britain.

LIST OF PRIZES

Prizes will be awarded for the three best entries *from each Section* as follows:—

FIRST PRIZE: Meccano products to the value of £3-3s.

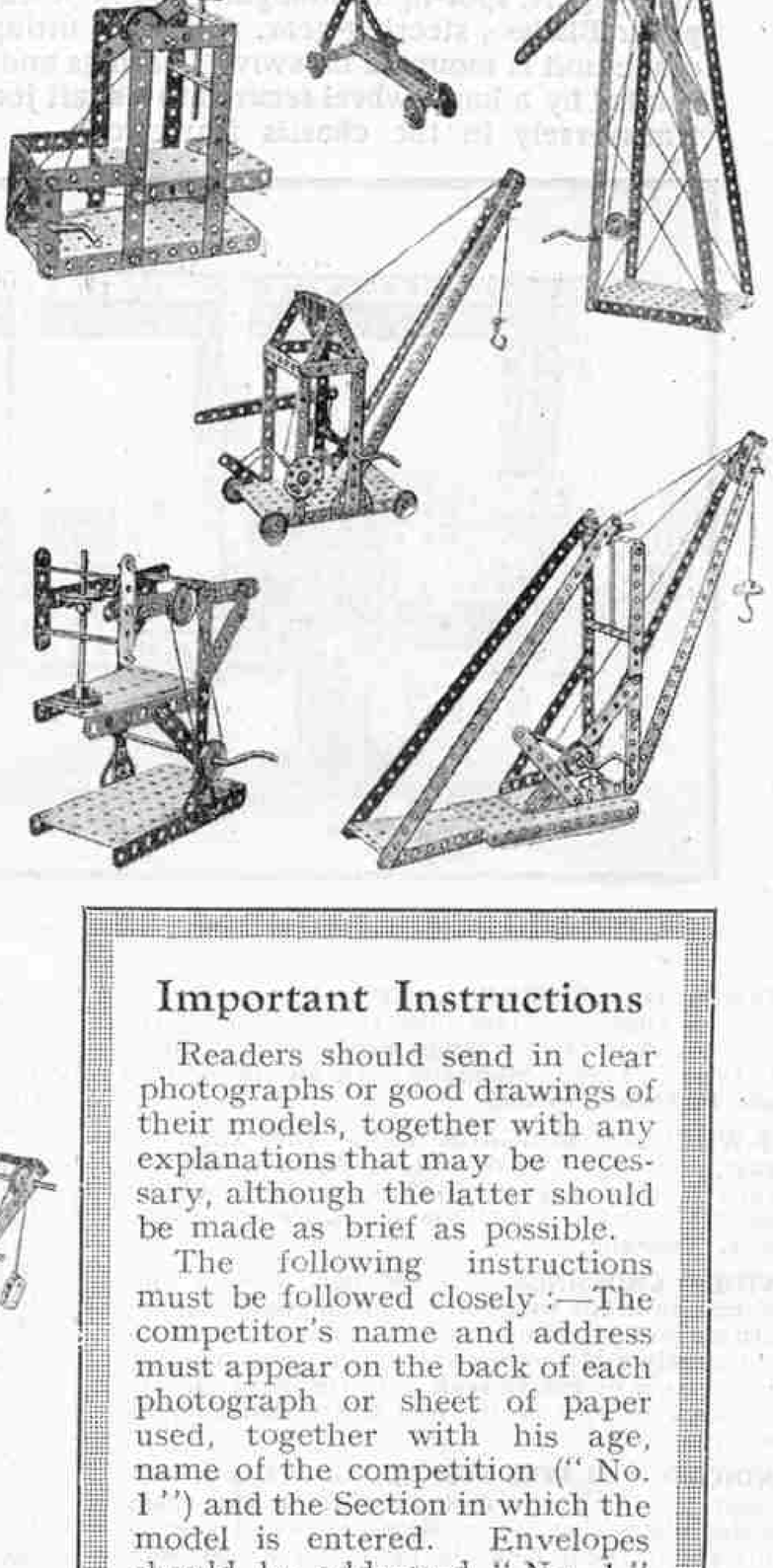
SECOND PRIZE: Meccano products to the value of £2-2s.

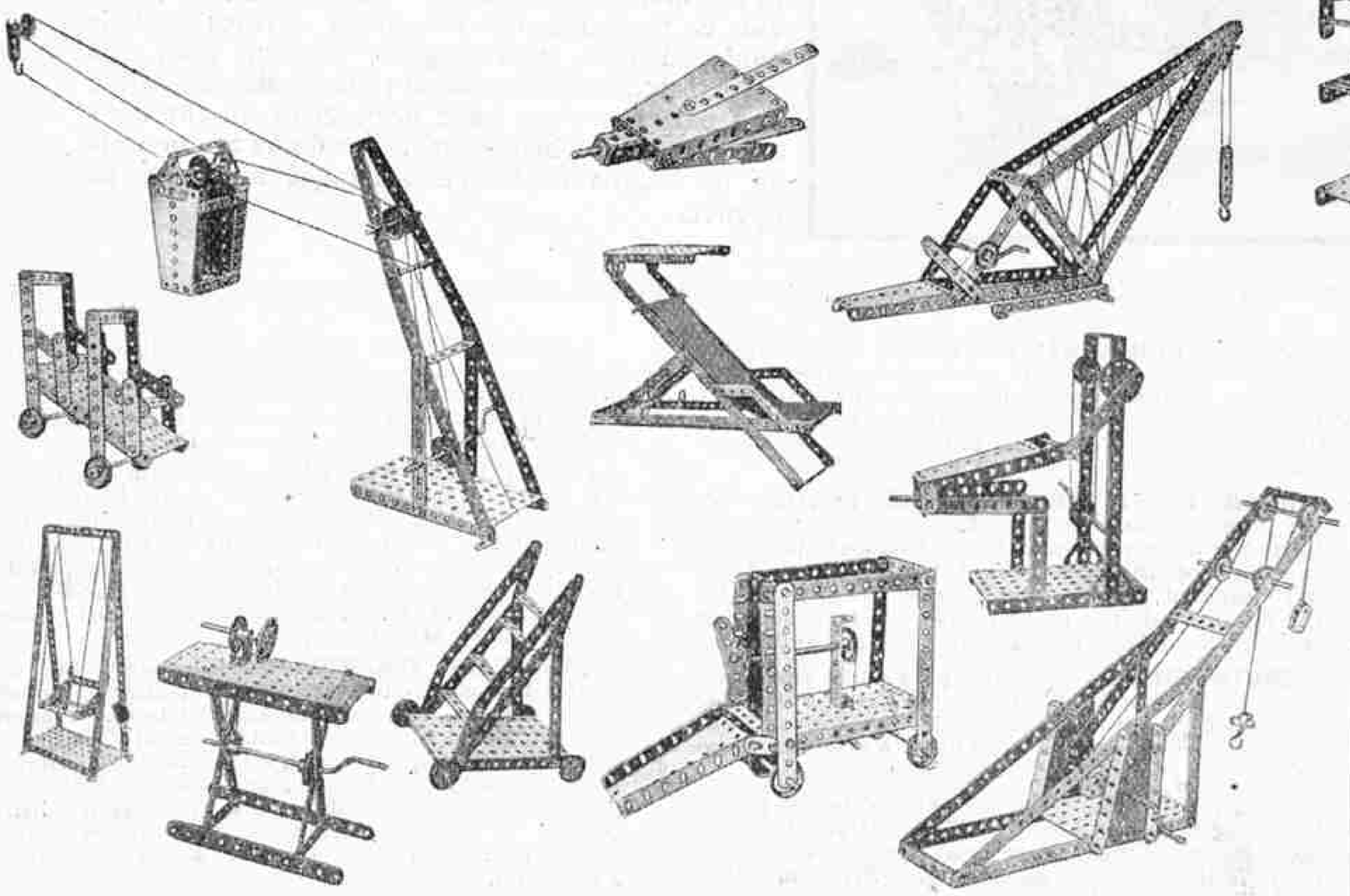
THIRD PRIZE: Meccano products to the value of £1-1s.

SIX PRIZES, each consisting of Meccano products to the value of 10/6.

Closing date for Sections A, B, and C: 31st March. Section D, 30th July, 1927.

Actual models should not be sent. A clear photograph or good drawing is all that is necessary. Photographs or drawings of unsuccessful entries will be returned if a stamped addressed envelope of the necessary size is enclosed with the entry. It should be noted, however, that photographs of prize-winning models become the property of Meccano Limited.





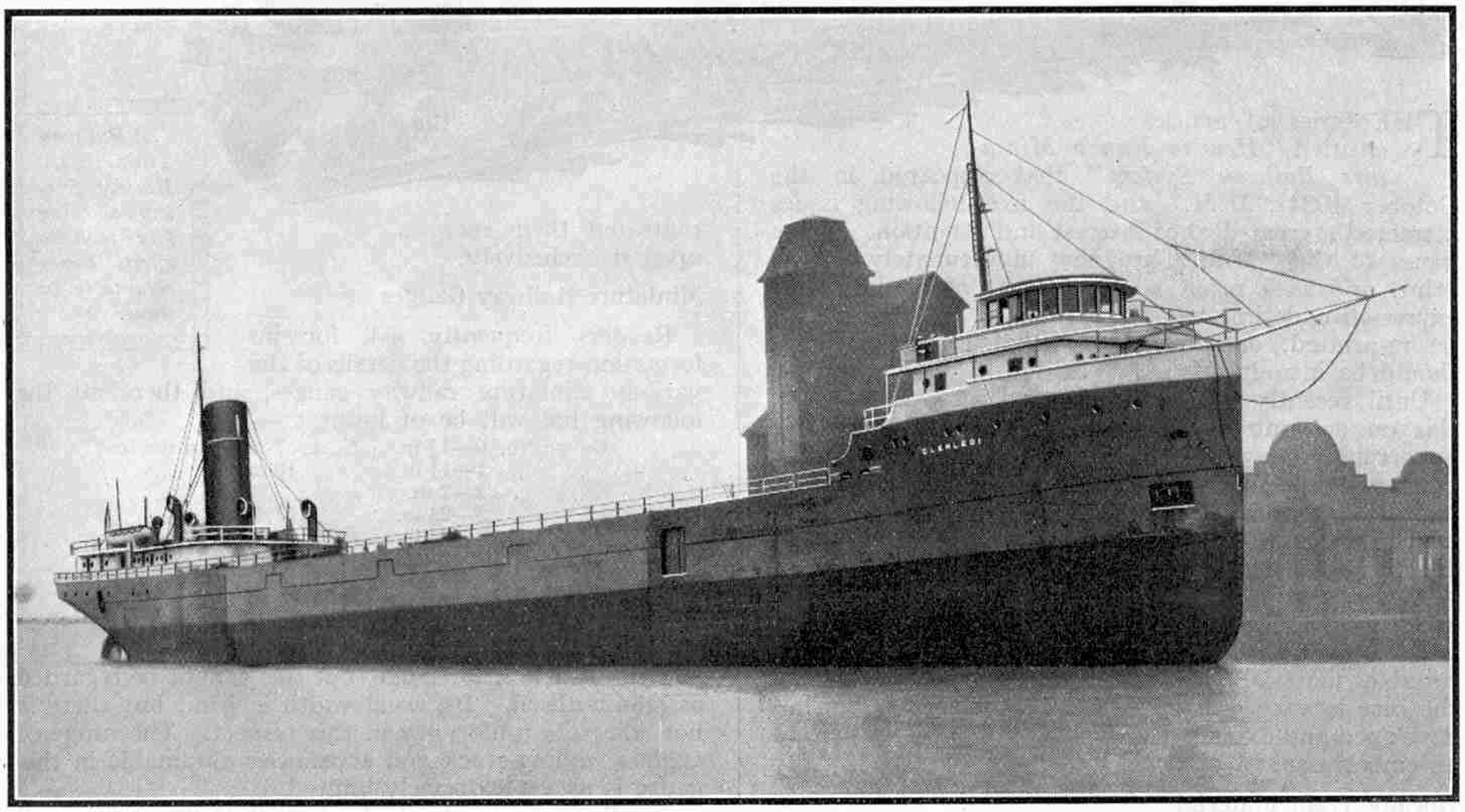
Important Instructions

Readers should send in clear photographs or good drawings of their models, together with any explanations that may be necessary, although the latter should be made as brief as possible.

The following instructions must be followed closely:—The competitor's name and address must appear on the back of each photograph or sheet of paper used, together with his age, name of the competition ("No. 1") and the Section in which the model is entered. Envelopes should be addressed "No. 1" Competition, Meccano Ltd., Binns Road, Liverpool.

Cutting a Ship in Two!

A Remarkable Engineering Feat



IN the "*M.M.*" of March last we gave an illustration and description of the "*Glenledi*," an interesting steamship built by Swan, Hunter and Wigham Richardson Ltd., at their Wallsend shipyard on the Tyne.

The "*Glenledi*" was built to the order of the Great Lakes Transportation Company Ltd. of Midland, Ontario, for service on the Great Lakes of Canada. She was designed to carry about 4,825 tons on 18 ft. draught in fresh water and her ultimate length was intended to be 379 ft. This length, however, was too great to allow her to pass through the locks of the Welland Canal, Ontario.

This serious difficulty was surmounted in a very interesting and ingenious manner. The vessel was reduced to the necessary size by omitting 144 ft. of the midship body! This portion, which also was constructed at the Wallsend yard, was taken out to the Great Lakes in the "*Glenledi*" herself.

After passing through the Welland Canal the vessel was docked and cut in two and the midship portion was then built into position, thus completing the full length of 379 ft. and leaving her as shown in our illustration.

The Welland Canal, which is now undergoing reconstruction for the third time since its opening in 1829, is the most important of the Canadian inland waterways. It cuts through the Niagara Peninsula, which juts out between Lake Erie and Lake Ontario, and links up these two vast sheets of water. The history of the canal really began in 1816, when a Government Commission was appointed to consider and report on Canadian inland navigation. The report, presented in 1823, proposed a scheme for the construction of a canal across the peninsula, of sufficient size to enable the passage of the vessels in use on the lakes. The original canal, which was built by a private company, had 40 locks each 110 ft. in length, 22 ft. in width, and 8 ft. in depth.

After some 20 years' service the canal was taken over by the Government and enlarged and re-constructed. A second re-construction was commenced in 1874 and was not completed until 1882, the canal then having 25 locks with a depth of 12 ft., the latter being increased five years later to 14 ft. The present reconstruction is undoubtedly one of the most important engineering operations now in progress in the Empire.

It is interesting to re-call that on a previous occasion Swan, Hunter and Wigham Richardson Ltd. were concerned in the cutting in two of a steamship built by them. The vessel in question was the "*Milwaukee*," which went ashore near Peterhead, late in 1898. It was found impossible to float the whole vessel but, as careful examination showed that the after part was not damaged, it was decided to cut her in two and make use of the sound portion. The cut was carried out by dynamite and the after part of the ship thus freed was towed to the Tyne. The builders then built and fixed on a new fore part with complete success and the vessel afterwards commenced a useful career in the North Atlantic service.

Running a Miniature Railway

How to Get the Most Fun Out of Your Train System

A Pullman Train in the Hornby System showing the realistic effects easily obtainable in Gauge 0.

THE series of articles entitled "*How to Run a Miniature Railway System*" that appeared in the October 1924 "*M.M.*" and the five following issues attracted a great deal of interest and attention. These issues of the "*M.M.*" are now unfortunately out of print, and as a result large numbers of readers have expressed a desire that the articles in question should be re-printed, or alternatively that a similar series should be introduced.

Until recently it has been found impossible to do this on account of limitations of space. A suitable opportunity now arises, however, as the result of the permanent enlargement of the magazine, and this month we commence the first of another series of articles which, we hope, will be of interest and value to all Hornby Train enthusiasts.

A few years ago the locomotives, rolling stock and accessories comprised in the Hornby Railway System were comparatively few in number and the choice of suitable material presented little difficulty. To-day the case is very different however, for the system has developed and extended to such an extent as to present an embarrassment of riches!

Hornby Train Material

Before deciding on the purchase of Hornby Train material the question of the space available for the track should be given careful consideration. The whole of the Hornby Train System is based upon the most popular of all gauges for miniature railways, namely, Gauge 0. In reference to railways, the word "gauge" means the width of the track measured from inside to inside of the heads of the rails, and the width of Gauge 0 rails is $1\frac{1}{4}$ in.

The advantage of this gauge as compared with the larger miniature railway gauges such as Gauge 1 ($1\frac{3}{4}$ in.), Gauge 2 (2 in.), Gauge 3 ($2\frac{1}{2}$ in.), etc., is that it permits of the laying out of a really interesting system in the all-too-limited space available in an ordinary small living room. Gauge 0, therefore, is the most suitable and convenient for the average boy, and for this reason Meccano Ltd. have concentrated their energies upon it exclusively.

Miniature Railway Gauges

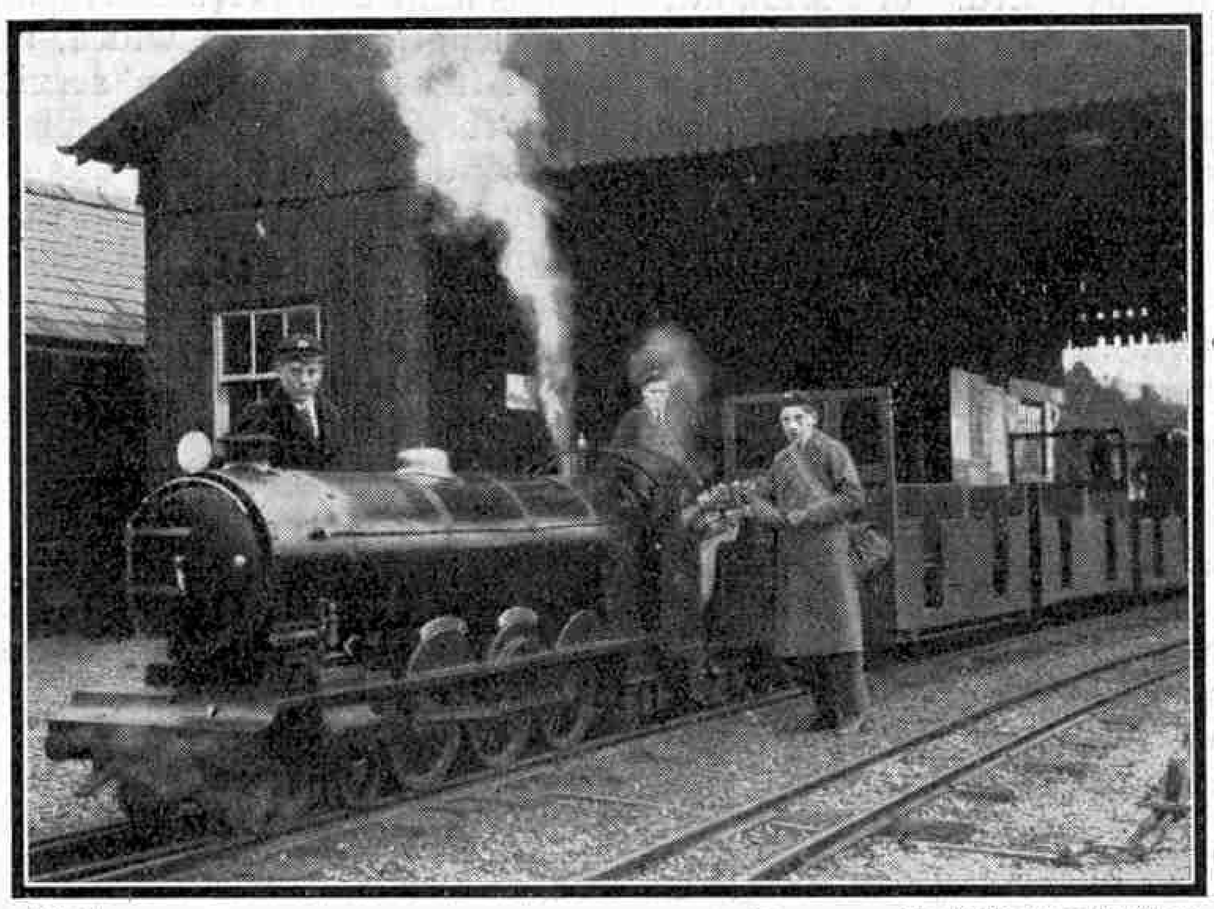
Readers frequently ask for information regarding the details of the various miniature railway gauges, and therefore the following list will be of interest:—

Gauge No. 0	—$1\frac{1}{4}$ in.	Scale 7 m.m.	to the foot
,, ,, 1	—$1\frac{3}{4}$ in.	,, 10 m.m.	,,
,, ,, 2	—2 in.	,, 7/16 in.	,,
,, ,, 3	—$2\frac{1}{2}$ in.	,, 17/32 in.	,,
	$3\frac{1}{4}$ in.	,, 11/16 in.	,,
	$3\frac{1}{2}$ in.	,, $\frac{3}{4}$ in.	,,
	$4\frac{3}{4}$ in.	,, 1 in.	,,
	$7\frac{1}{4}$ in.	,, $1\frac{1}{2}$ in.	,,
	$9\frac{1}{2}$ in.	,, 2 in.	,,
	15 in.	,, 3 in.	,,

There is also a 00 Gauge, but this cannot be regarded as standardised. Its usual width is $\frac{5}{8}$ in., but there is not complete uniformity in this respect. The range of engines, rolling stock and accessories obtainable in this gauge is as yet extremely limited.

No. 2 Gauge is about the largest that can be used for an indoor line and the larger gauges are specially adapted for garden and other outdoor railways. The $7\frac{1}{4}$ in. Gauge is the smallest that can be used safely and satisfactorily for carrying passengers.

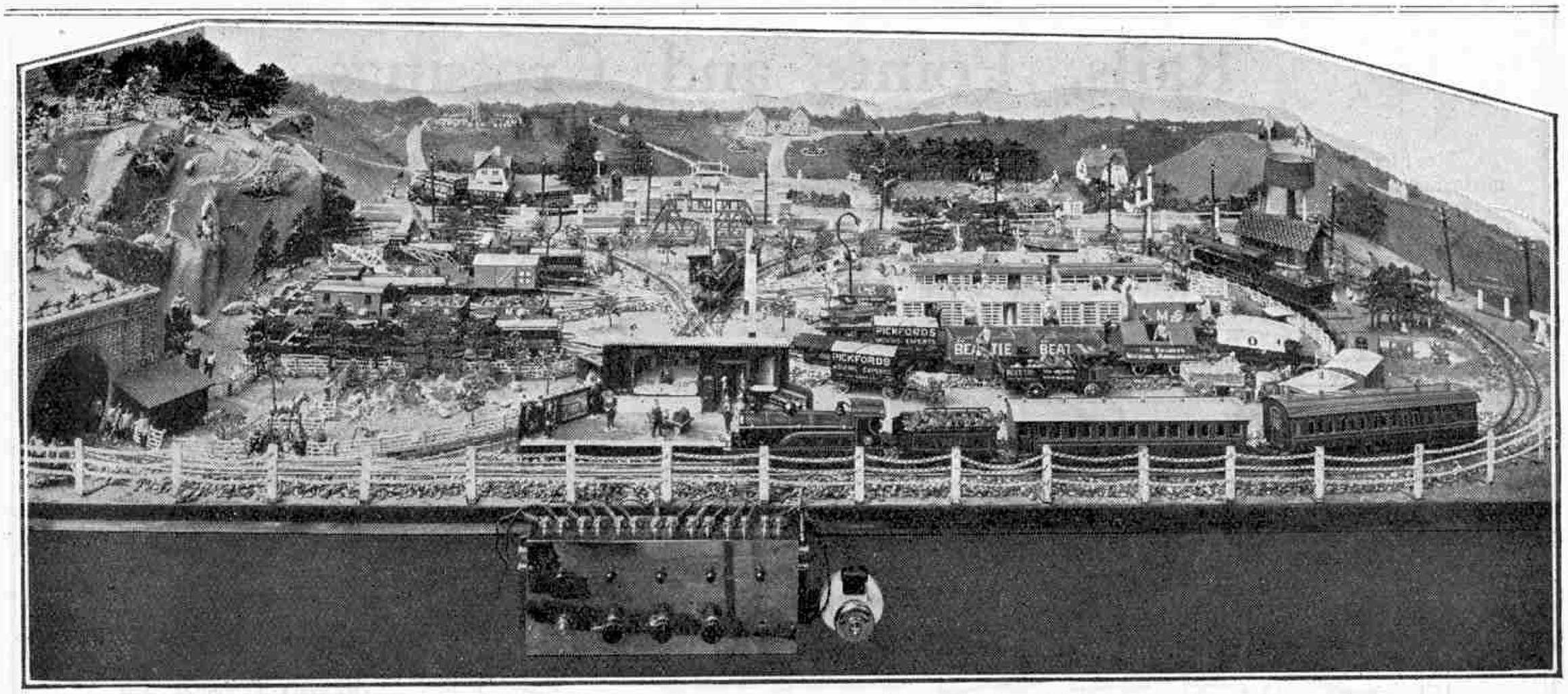
The Eskdale 15″ Gauge Railway



Photo] [*G. Williamson (Wigton)*

"Sir Aubrey Brocklebank," one of the fine engines of the Eskdale Railway, and some of his admirers

The largest gauge of all, 15 in., brings us really into the domain of light railways, and it is used with complete success in various parts of England and on the Continent. One of the finest examples of railways of this gauge is the Eskdale Railway in Cumberland. This railway was formerly the Ravenglass and Eskdale Railway, of 3 ft. gauge, and was opened on 24th May, 1875. It failed to pay its way, however, its traffic came to an end, and for a considerable time it remained abandoned and derelict. On 24th July, 1911, the present company was

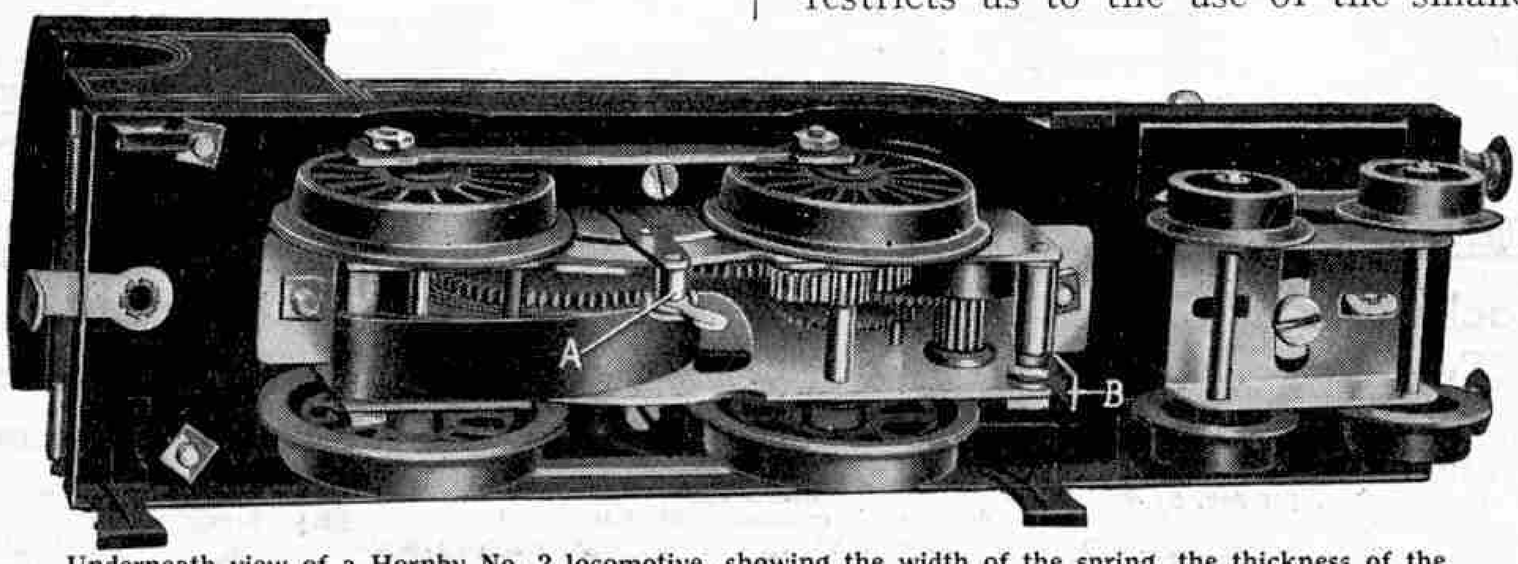


A fine example of the pictorial possibilities of a miniature railway layout

incorporated and the line was re-laid on the 15 in. gauge and re-opened on 20th August, 1915.

To-day the Eskdale Railway not only carries a steady stream of passengers over its length of just over seven miles, but also hauls coal, food and other stores to the villages through which the line passes, in addition to conveying His Majesty's mails. The track abounds in steep gradients and sharp curves and therefore a high average running speed is not possible. In spite of this, however, the interesting "*Green Goddess*" loco designed by Mr. Henry Greenly, A.I.Loco.E., for Capt. J. E. P. Howie, the well-known racing motorist, when undergoing her trials achieved a speed over one part of the line of 35 miles an hour.

Notwithstanding its small size, the Eskdale Railway is thoroughly capable of earning its own living, and it has attained the dignity of having the times of its trains recorded in "*Bradshaw*." This official recognition must be unique in respect to a railway of so small a gauge.



Underneath view of a Hornby No. 2 locomotive, showing the width of the spring, the thickness of the gear wheels and the strong construction throughout

Large and Small Radius Curves

Returning now to the Gauge 0 Hornby track, while the whole of this is the same width, it is made on two different scales as regards curves. In the sets containing the larger engines and rolling stock, a complete circle made of the curved rails supplied has a radius of 2 ft., whereas in the corresponding sets for the smaller engines the circle is only of 1 ft. radius. This question of radius has a very important bearing upon the success or otherwise of a miniature railway.

As regards ease and smoothness of running, there is not the slightest doubt that the large radius rails are superior to those of small radius, but on the other hand the amount of space occupied by any particular layout using large radius rails is very much greater than if the small curves are used. If the space available for the layout is sufficiently extensive, large radius curves should be chosen, because they permit of the use of any and every locomotive in the Hornby system. On the other hand, if the small radius rails are used, the larger vehicles, on account of their length of wheel-base, are unable to negotiate the curves successfully. It should be remembered further that, while the smaller engines and rolling stock run with perfect success on the small radius rails, their performance is even better on the larger curves.

If the available space is very limited it is usually wise to use the small radius rails, even though this restricts us to the use of the smaller engines. If the large radius rails are used in a very confined space the curves take up so much room that only the simplest layout is possible; whereas the smaller curves allow an infinitely more interesting and railway-like system to be laid out in the same space.

It should always be borne in mind that, whether the large radius or the small radius rails be adopted, exactly the same wide range of points, crossings and accessories of all kinds is available.

Permanent Layouts

We come now to the layout itself. Some boys are fortunate enough to have at their disposal an attic or other spare room where a track may be laid and kept down permanently. In such cases the possibilities in regard to layout are almost unlimited. The majority of permanent tracks of this nature are laid out on plank shelves round the room, or on a large table in the centre of the room, with possibly extensions at one or both ends of the table.

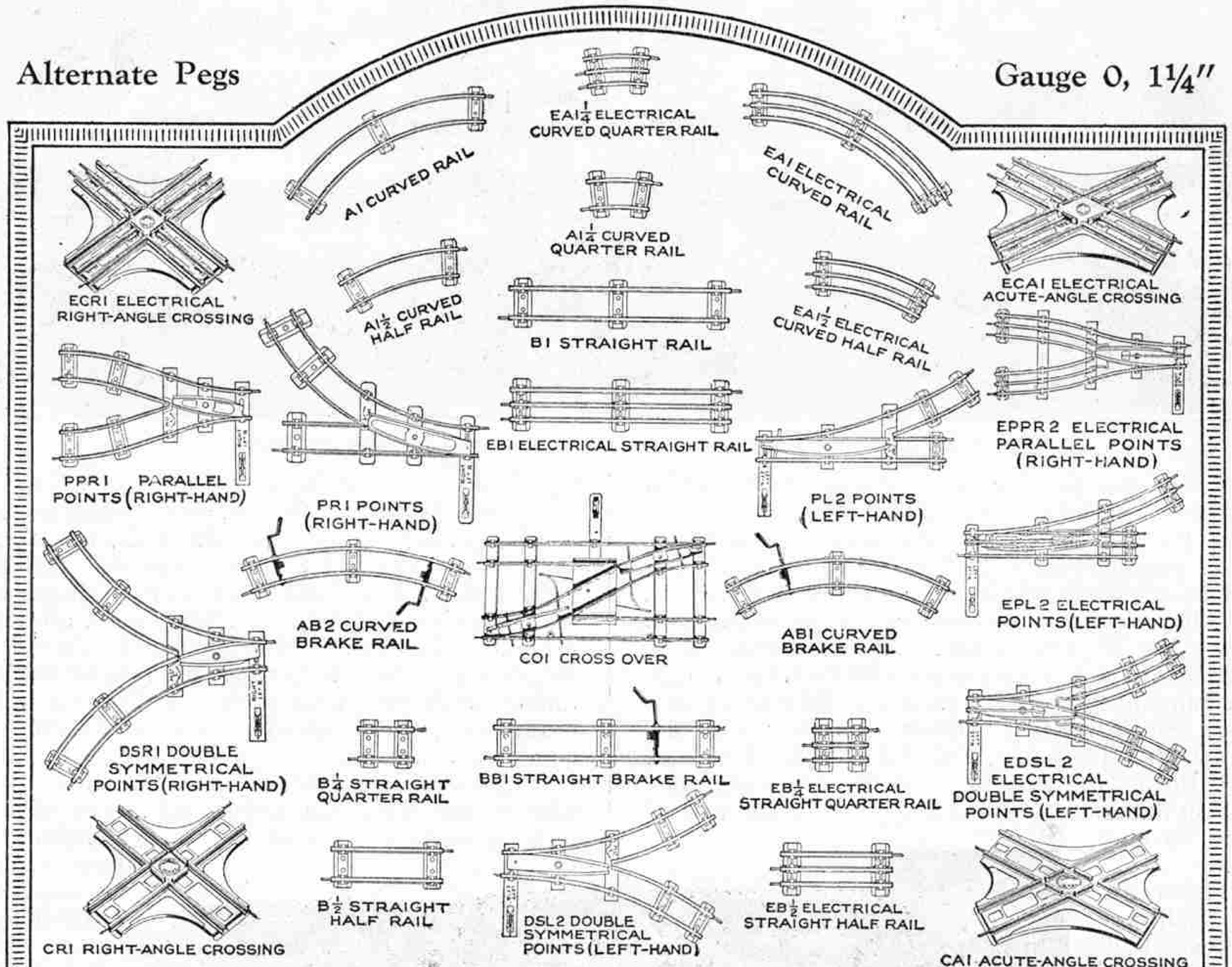
In the case of a track around the room, this may consist of smoothly-planed planks resting (*Continued on page* 155)

Rails, Points and Crossings

Hornby Series

Hornby Rails, Points and Crossings are built for hard wear and for smooth running. They are made of the finest materials and hold together rigidly and strongly, for real workmanship is put into them. Note the great superiority both in quality and appearance of the Hornby rails.

Alternate Pegs — **Gauge 0, 1¼"**



The addition of straight and curved brake rails supplied for Clockwork Trains makes possible a great deal more fun. By the use of the straight brake rail, trains may be brought to a standstill at the station platform in a very realistic manner.

Rails for Clockwork and Steam Trains

CURVED RAILS

For 1-ft. 6-ins. diameter circle

A9	Curved rails (9-in. radius) ...	per doz.	3/–

For 2-ft. diameter circle

A1	Curved rails (1-ft. radius) ...	per doz.	4/6
A1½	Curved half rails „ ...	„	3/6
A1¼	Curved quarter rails „ ...	„	3/–
AB1	Curved brake rails „ ...	each	6d.

For 4-ft. diameter circle

A2	Curved rails (2-ft. radius) ...	per doz.	4/6
A2½	Curved half rails „ ...	„	3/6
A2¼	Curved quarter rails „ ...	„	3/–
AB2	Curved brake rails „ ...	each	6d.

DOUBLE SYMMETRICAL POINTS

For 1-ft. radius curves

DSR1	Double symmetrical points, right	each	2/6
DSL1	Double symmetrical points, left	„	2/6

For 2-ft. radius curves

DSR2	Double symmetrical points, right	each	2/6
DSL2	Double symmetrical points, left	„	2/6

PARALLEL POINTS

For 1-ft. radius curves

PPR1	Parallel points, right	each	2/6
PPL1	Parallel points, left	„	2/6

For 2-ft. radius curves

PPR2	Parallel points, right	each	2/6
PPL2	Parallel points, left	„	2/6

CROSSINGS

CA1	Acute-angle crossings (for 1-ft. radius rails)	each	1/9
CA2	Acute-angle crossings (for 2-ft. radius rails)	„	1/9
CR1	Right-angle crossings (for 1-ft. radius rails)	„	1/9
CR2	Right-angle crossings (for 2-ft. radius rails)	„	1/9

POINTS

For 9-ins. radius curves

PR9	Right-hand points	each	2/3
PL9	Left-hand points	„	2/3

For 1-ft. radius curves

PR1	Right-hand points	each	2/3
PL1	Left-hand points	„	2/3

For 2-ft. radius curves

PR2	Right-hand points	each	2/3
PL2	Left-hand points	„	2/3

STRAIGHT RAILS

B1	Straight rails	per doz.	4/–
B½	Straight half rails	„	3/–
B¼	Straight quarter rails	„	2/6
BB1	Straight brake rails	each	5d.

CROSSOVERS

CO1	Crossover (1-ft. radius)	each	6/6
CO2	Crossover (2-ft. radius)	„	7/6
CP	Rail connecting plates	½ doz.	4d.

Rails for Electric Trains

STRAIGHT RAILS

EB1	Straight rails	per doz.	7/–
EB½	Straight half rails	„	4/6
EB¼	Straight quarter rails	„	4/–

CURVED RAILS

For 2-ft. diameter circle

EA1	Curved rails (1-ft. radius) ...	per doz.	8/–
EA1½	Curved half rails „ ...	„	5/–
EA1¼	Curved quarter rails „ ...	„	4/6

For 4-ft. diameter circle

EA2	Curved rails (2-ft. radius) ...	per doz.	8/–
EA2½	Curved half rails „ ...	„	5/–
EA2¼	Curved quarter rails „ ...	„	4/6

CROSSINGS

ECA	Acute-angle crossings	each	4/–
ECR	Right-angle crossings	„	4/–

POINTS

For 2-ft. radius curves

EPR2	Right-hand points	each	5/–
EPL2	Left-hand points	„	5/–

For 2-ft. radius curves

EDSR2	Double symmetrical points, right	each	6/–
EDSL2	Double symmetrical points, left	„	6/–

For 2-ft. radius curves

EPPR2	Parallel points, right	each	6/–
EPPL2	Parallel points, left	„	6/–
TCP	Terminal connecting plates ...	„	1/6

Electrical Points, Double Symmetrical Points and Parallel Points for 1-ft. radius curves are not supplied.

Manufactured by MECCANO LIMITED, BINNS ROAD, LIVERPOOL

Running a Miniature Railway—

(*Continued from page* 153)

either on trestles or on some kind of brackets fixed to the wall. The foundation is usually wide enough to accommodate a double track and at one or more points it is widened to allow of the layout of stations and sidings. The large central table may be one constructed entirely of planks or may be an ordinary large table extended by planks on trestles as required.

Introducing Realism

A layout resting on a plain wooden foundation does not look very realistic and few real enthusiasts will rest content with this state of affairs. Fortunately it is comparatively easy to effect a remarkable improvement in realism by simple and inexpensive means. For instance, when the layout has been decided upon and the track is in position and fixed down either by hook nails or by screws through the sleepers, the whole may be ballasted, using some such material as very small granite chips or finely crushed coke, banked to the level of the sleepers. The portions of the wooden foundation that are not covered by the ballast may be camouflaged effectively by painting them over with very thin glue and sprinkling sand over the whole, subsequently dusting or brushing away any sand that the glue has not fixed in position. Some enthusiasts take matters a stage further by coating all the sleepers with black enamel.

It is not at all difficult also to provide a really picturesque background of suitable scenery. Very often by searching through a book of wallpaper patterns a suitable frieze with a country scene design may be selected that will meet all requirements. Alternatively, if the model railway engineer has any artistic ability or can secure the assistance of a friend who is clever in this direction, sufficiently realistic scenery may be painted on a background of some neutral tinted paper. It is surprising, until one tries it, how effective even the crudest work of this nature will appear.

In a future article we hope to return to this subject and to give detailed instructions for the preparation of scenic surroundings that will greatly enhance the appearance of any model railway.

In the case of a layout running around the room it is, of course, necessary to make provision for the opening of the door of the room, and generally this is most easily carried out by means of a lifting bridge. Later we shall deal with this matter also.

Temporary Tracks

The majority of boys, however, have to make the best of the table or floor in a living room, where the track has to be taken up after use and laid down afresh each time it is wanted. In most cases the floor will be employed, because the average table does not offer sufficient space for the development of an interesting layout, even with the small radius curves. The nature of the layout obviously must vary greatly with the size and shape of the room and the arrangement of the larger pieces of furniture, and for this reason it is very difficult to give advice that will be generally applicable. The possibilities of various layouts will be reviewed later, however, with the object of making clear the main principles that underly all effective and railway-like schemes.

All boys do not obtain their enjoyment from their miniature railways in the same manner. For instance, to some boys the engine is the main consideration, and they revel in pitting one engine against another and testing them in regard to speed, hauling power and length of run. Other boys merely regard their engines as part of the whole system and obtain their greatest pleasure by running trains, passenger and goods, express and slow, to a definite time-table. Time-table working with miniature railways is quite an art in itself and later we hope to show how fascinating it can be made. In addition there are boys who revel especially in the laying out and operation of complicated systems of sidings, and who will spend hours on end in working out shunting operations. In future instalments of this series we intend to deal with all these points of view and to show how the best fun may be obtained in each case.

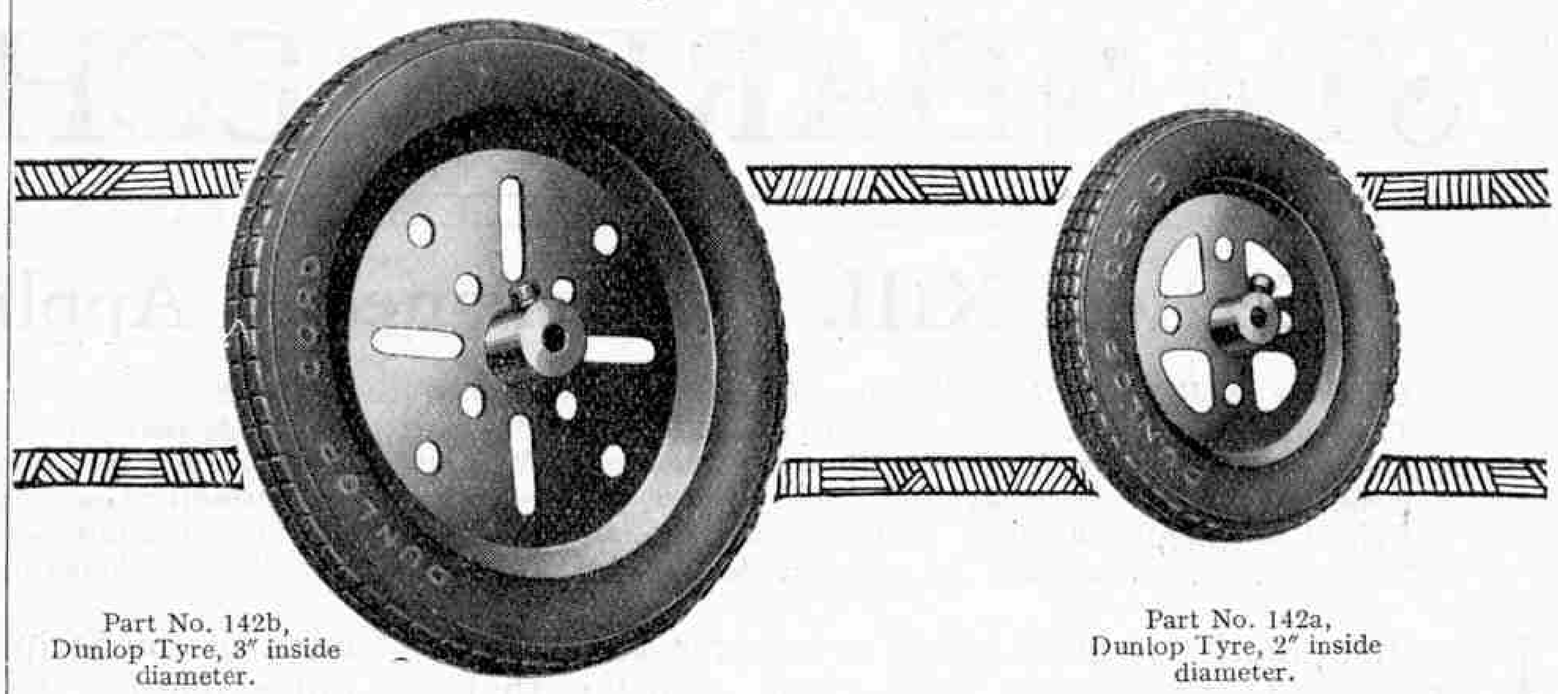
Care of the Track

In the meantime it should be emphasised that continual laying down and taking up of the track imposes a severe strain upon it, and although the Hornby track is very strongly constructed, a reasonable amount of care in its use is necessary. In particular, care should be taken to avoid damage to points and crossings because if these, owing to rough handling, become bent out of shape, smooth running is impossible and derailments may result.

Next month we shall show how the best results are to be obtained from clockwork engines.

Dunlop Tyres for Meccano Models

Add the Finishing Touch to Miniature Motors



Part No. 142b, Dunlop Tyre, 3″ inside diameter.

Part No. 142a, Dunlop Tyre, 2″ inside diameter.

We feel sure that a great number of our readers will welcome with enthusiasm the news that scale model motor tyres are now included in the Meccano system. We have experienced a demand for these accessories for some time past and in order to fulfil the requirements of hundreds of Meccano boys we arranged with the Dunlop Rubber Co., Ltd., to manufacture and supply exact replicas in miniature of the famous Dunlop Cord Tyres.

In consequence of these arrangements we are now able to place the tyres upon the market in two different sizes, as shown in the accompanying illustrations.

The larger tyre has an internal diameter of 3″ and a maximum diameter (from tread to tread) of 4″. It is shown fitted to the Meccano 3″ Pulley Wheel. The smaller size is of 2″ inside diameter, or about $2\frac{7}{8}$″ over all, and is designed for use with the 2″ Pulley Wheel.

The tyres are beautifully made and the well-known "non-skid" tread stands out in bold relief. It is scarcely necessary for us to add that they form excellent accessories for the Meccano Motor Chassis. Indeed, it is difficult to imagine a more pleasing model than that presented by the chassis fitted with scale model tyres, in addition to its existing realistic mechanical details. Meccano boys will do well to follow their fathers' examples and "Fit British tyres (to their models) and be satisfied!"

The prices of the Meccano tyres are as follows:—

Part No. 142a, Dunlop Tyre, 2″ inside diameter, to fit Meccano Pulley Wheels ... 4d. each
Part No. 142b, Dunlop Tyre, 3″ inside diameter, do. do. ... 6d. each

Britain's Most Powerful Loco—

(*Continued from page* 99)

only once dropped below 60 m.p.h.

The details of this run are recorded in the table shown on page 99.

Extraordinary Public Interest

The public interest in this great locomotive has been intense and at Waterloo it has been literally besieged by railway enthusiasts. Additional interest also is lent by the fact that the "*Lord Nelson*" is one of the few locomotives to have been driven by Royalty. The Duke and Duchess of York recently paid a visit to Ashford to fulfil certain engagements, including an inspection of the Southern Railway's works. After visiting the various erection shops, the Duke and Duchess concluded their tour by mounting the footplate of the "*Lord Nelson*," the Duke taking charge of the regulator and driving the engine from the works into Ashford station.

Other engines of the "Nelson" Class are to be built and will be named after the following famous sailors:—Lord St. Vincent, Lord Howe, Lord Rodney, Lord Hood, Lord Hawke, Howard of Effingham, Sir Francis Drake, Sir Walter Raleigh, Sir Richard Grenville and Martin Frobisher.

It is not intended to supersede the "King Arthur" Class and in fact further engines of this well-known type are to be constructed in the near future.

MECCANO
STANDARD MECHANISMS

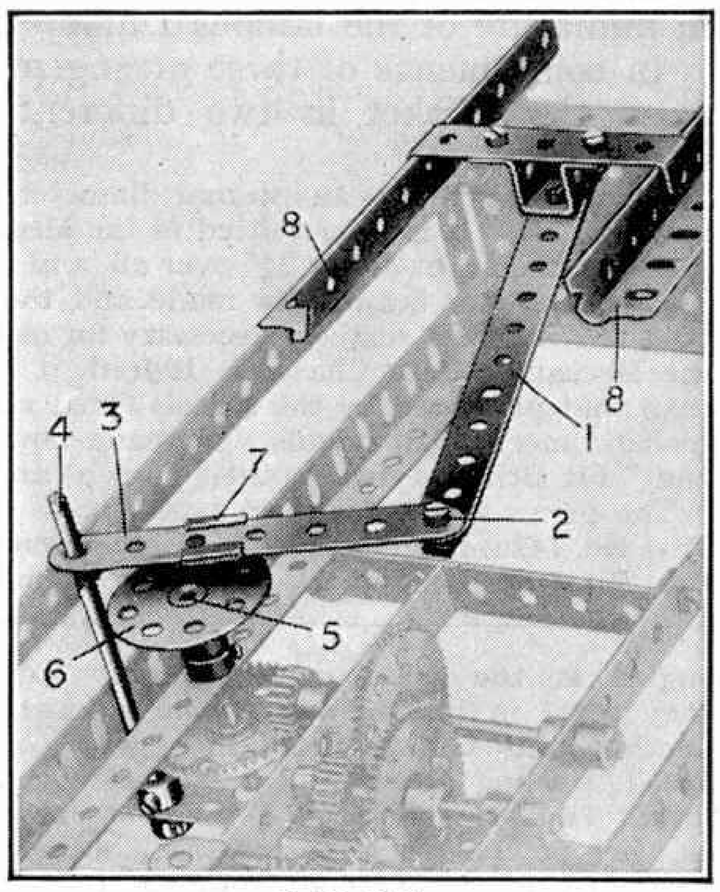
Section XIII. Miscellaneous Appliances—(*continued*)

Below we publish a further selection of Meccano movements included under Section XIII of "Meccano Standard Mechanisms." These Meccano movements have been termed "Standard Mechanisms" for the reason that they may be adapted with advantage to numerous Meccano models—in most cases without any alteration, but in some few instances with slight alterations to the standard movement. We have already dealt with a number of interesting subjects, including Gear Ratios, Belt Mechanism, Pulleys, Levers, Drive-Changing Mechanisms, Brakes, Steering Gear, Screw and Traversing Mechanisms, Grabs and Dredging Apparatus, etc. Section XIII, which is the last of the present series, will be concluded in next month's "M.M."

IN actual practice a quick-return gear forms a valuable means of speeding-up production and for that reason it is adapted to numerous types of machine tools, etc. When fitted to a planing-machine for example, as in S.M. 261, this gear so controls the drive that the table carrying the material to be shaped moves slowly during the cutting stroke, but on the return movement, during which the cutting tool performs no work on the material, the table travels much faster.

A vertical driven shaft 5 carries a Bush Wheel 6 to which an Eye Piece 7 is pivoted by means of bolt and lock nuts (see S.M. 263). A 3½" Strip 3 passed through the Eye Piece pivots about an upright fixed Rod 4, and is attached pivotally at its outer end 2 by bolt and nuts to a connecting lever 1. The latter, in turn, is connected pivotally to the underside of the table, which slides on the girders 8.

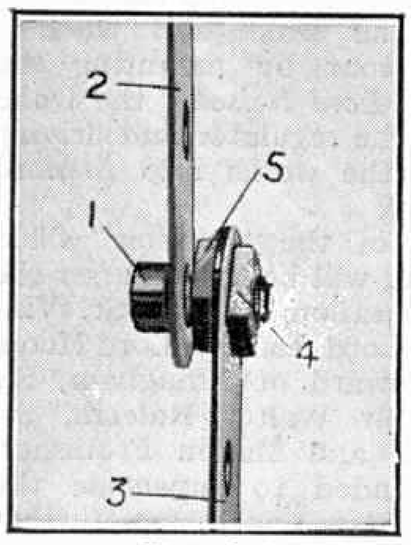
The Bush Wheel 6 rotates in an anti-clockwise direction, rocking the lever 3 to and fro, and the swivel-guide 7 slides on the lever as it follows the movement of the Bush Wheel. Consequently the guide 7 is at a greater distance from the fulcrum of the lever during the forward stroke than it is on the return, with the result that the point 2 moves slowly on the forward stroke and more rapidly on the return.



S.M. 261

S.M. 262—Pivot, Formed from Bolt and Nuts

It is often required in Meccano models to connect two Strips or other parts together in such a way that one or both may have perfectly free rotary movement about the joint. A simple type of pivot, or swivel-bearing, which proves extremely useful in this connection is shown in S.M. 262.



S.M. 262

The bolt 1 passes through the Strip 2 and is securely held to Strip 3 by means of two nuts 4 and 5, which are screwed tight against opposite sides of the Strip. Sufficient space is left between the nut 5 and the bolt head to allow free movement of the Strip 2. This arrangement makes it quite impossible for the pivotal connection to work loose or, oppositely, to "bind" while in operation.

The device may also be employed as a fixed axle or bearing for a Pulley Wheel, etc., by substituting for the bolt 1 another of greater length, or a Pivot Bolt, to allow for the additional width of the Pulley.

S.M. 263—Bolt and Lock-Nuts

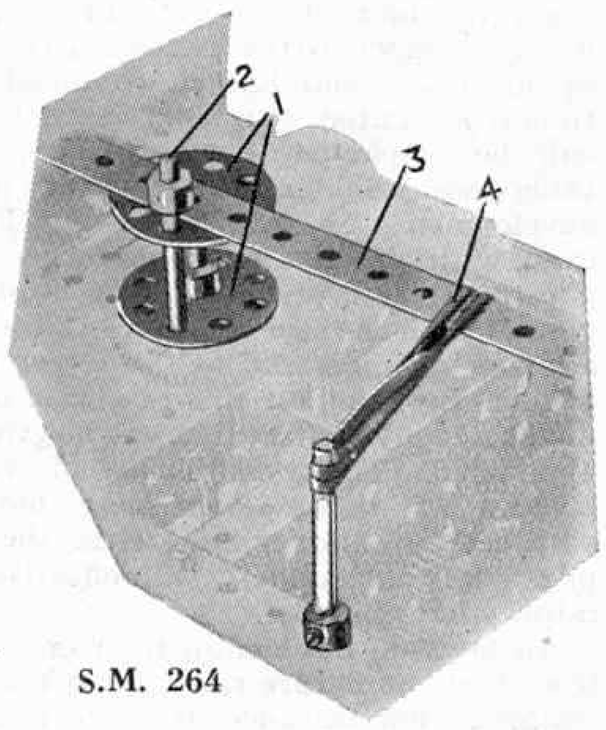
Another form of pivot or swivel-joint having similar functions to S.M. 262 may be constructed by first placing the Strips 2 and 3 (see illustration, S.M. 262) on the bolt 1 and locking the nuts 4 and 5 on its shank. The nuts are turned in opposite directions until they securely grip each other in position on the bolt.

This method allows for free movement of both Strips 2 and 3, independently of the bolt, but it is only in rare instances that it is likely to prove more efficient than the type of pivotal connection described under S.M. 262. The amount of play obtaining in the latter, for example, is not so great as in the bolt and lock-nuts method.

S.M. 264—Cam, or Tappet

S.M. 264 illustrates a simple method by which regular rotary motion may be converted into reciprocating or intermittent motion.

Two Bush Wheels 1 are mounted on a vertical rotating shaft and carry a short Rod 2 which pushes a lever 3 to and fro. The lever is held against the Rod 2 by means of a piece of elastic 4 (or Spring Cord). A suitable stop may be placed in position to prevent the lever following the Rod 2 through the full distance as the latter retreats; in this way

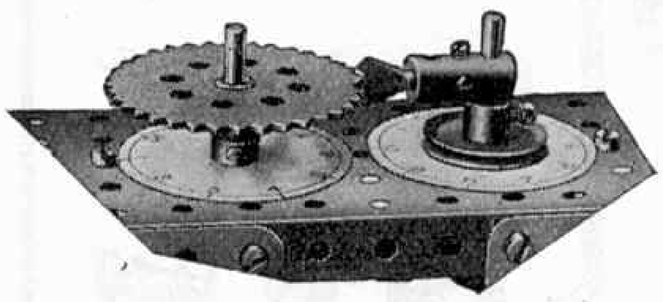


S.M. 264

intermittent motion will be produced, for the lever will become stationary at the end of each stroke, until the Rod 2 is again in position to push it outwards.

S.M. 265—Intermittent Rotary Motion

The device shown in this example is designed to impart intermittent rotary movement to a secondary shaft by means of a primary shaft that is in continuous rotary motion. A Centre Fork, carried in a Coupling secured to the primary shaft, engages for a brief period in each revolution with the teeth of a 2″ Sprocket Wheel secured to the secondary shaft, so imparting to the latter the required movement. This device is useful in revolution indicators, measuring instruments, etc.



S.M. 265

Intermittent rotary motion may also be obtained by means of Pawl and Ratchet gear, the arrangement of the necessary apparatus being principally as follows: A driving shaft is caused to actuate a rocking lever by means of crank or eccentric motion. The centre of oscillation of the lever coincides with the centre of the shaft that it is required to drive intermittently, and a Pawl, which is pivotally attached to a point in the length of the lever, engages the teeth of a Ratchet Wheel secured to this secondary shaft. Rotary motion is imparted to the Ratchet, and therefore the secondary shaft, during each forward stroke of the lever, while on the return stroke the Pawl rides idly over the teeth of the Ratchet and the secondary shaft remains stationary.

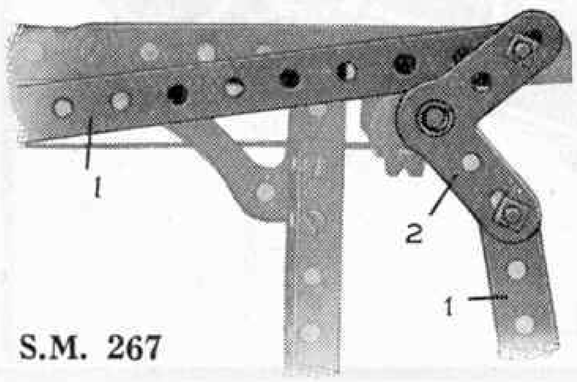
S.M. 266—Cam, or Tappet

This resembles S.M. 264 in that it converts a regular rotary motion into a reciprocating or intermittent motion. It consists of two 1½″ Pulley Wheels 1, or Bush Wheels, carrying three Double Brackets 2 and secured to a revolving shaft 3. As the cam rotates, the Brackets 2 raise or lower a lever resting transversely upon the Rod 3.

The extent of the movement of the lever may be varied, of course, by altering the number of Double Brackets 2. In the example illustrated, a slight pause would occur after each stroke of the lever, for the lever is allowed to rest momentarily on the Rod 3 while the cam portion 2 completes the lower half of its rotation.

The Eccentric is a form of cam and may be used for similar purposes. The functions of the Meccano Eccentric were made clear in S.M. 252 (see last month's "*M.M.*")

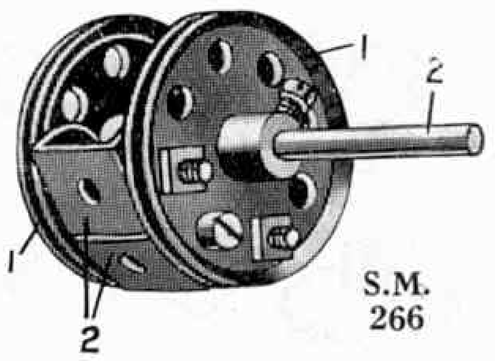
S.M. 267—Bell Crank



S.M. 267

The bell crank is a lever of the first order (see Section IV., page 11) and is employed as a means of altering the extent of the movement or power exerted by a force. It may also be used for changing the direction of a force.

In S.M. 267, the levers 1 are set at right-angles to each other, and one imparts motion to the other through the Bell Crank 2 (Part No. 128), to which the levers are pivotally connected by bolts and nuts (see S.M. 262). In this case no mechanical advantage is obtained by the use of the Bell Crank, since the levers are pivoted at equal distances from the fulcrum. If the length or relative angles of the levers are altered, however, the ratio of mechanical advantage varies accordingly, as will be understood clearly from Section IV.



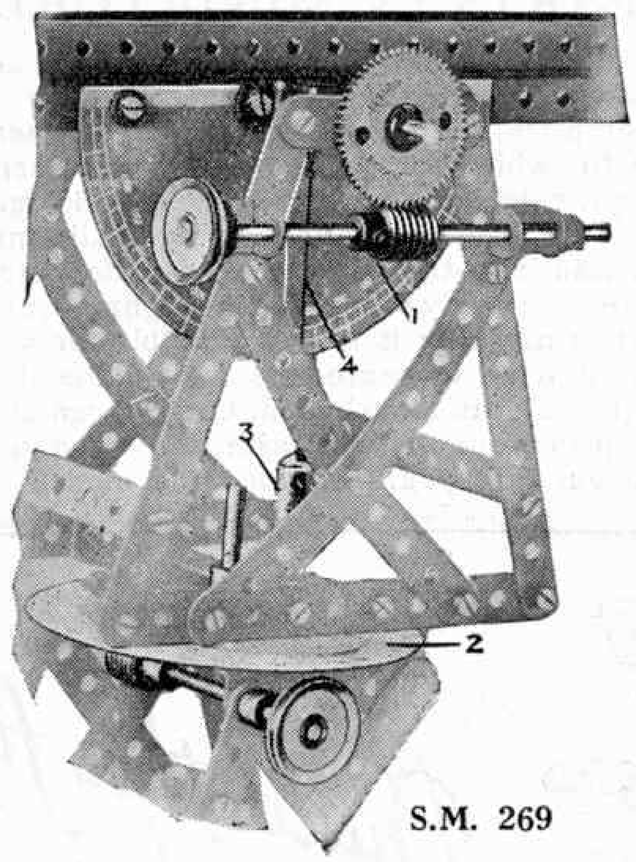
S.M. 266

If the levers 1 are placed in parallel positions, it is obvious that their direction of movement will be opposite. That is to say, if one lever moves longitudinally from left to right, the other will move from right to left.

S.M. 268—Epicycloidal Gear

In epicycloidal gear one toothed wheel is caused to rotate about the circumference of another. The Pinion 1 in S.M. 268 engages with the Gear Wheel 2, and is carried on a shaft journalled in a 1½″ Strip 3 bolted to a Contrate Wheel 4, which rotates freely upon the vertical Rod. The latter may be secured in position, so preventing the Gear Wheel 2 from turning, or it may be rotated at a different speed—or in an opposite direction—to the Contrate Wheel 4.

The number of revolutions described by the Pinion 1 always exceeds that of the Contrate Wheel 4, but the speed ratio varies according to the sizes of the Pinion and Gear Wheel 2, and to the movement (if any) of the latter.



S.M. 269

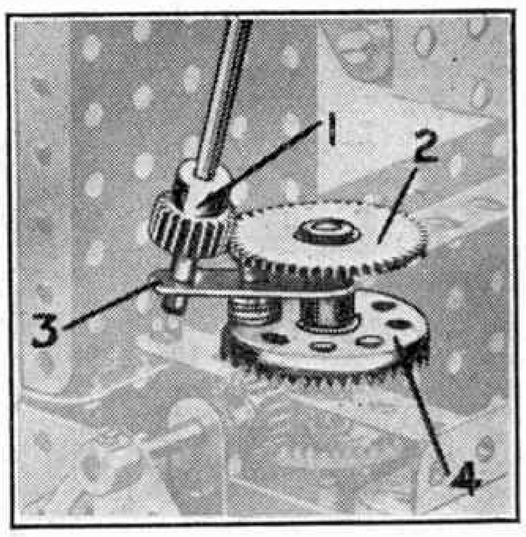
S.M. 269—Measurement of Angles

The Meccano Protractor (Part No. 135) consists of a sheet of superfine Esparto Board on which are printed graduated circular and semicircular scales. These may be cut out and affixed to models in which it is desired to measure angles, degrees, etc.

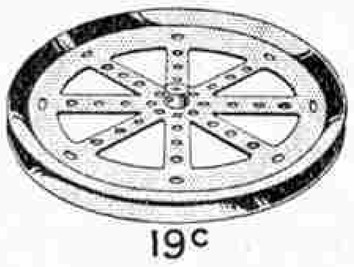
S.M. 269 shows the semicircular scale 1 and the circular scale 2 attached to the sighting arm and fixed base respectively of a theodolite, which, as every Meccano boy knows, is an instrument used in surveying and measuring. Note the "plumb-line"—the Coupling 3 suspended by cord 4—by which the perpendicular is ascertained.

The Meccano Theodolite (Model No. 605 in the Complete Manual) forms a very interesting instrument that may be put to practical purposes. Another excellent model that makes good use of the Protractor is the Sighting Apparatus (Model No. 508), with which the height of any object may easily be determined.

(*Further Standard Mechanisms appear on page* 159).



S.M. 268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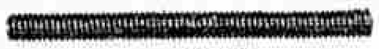
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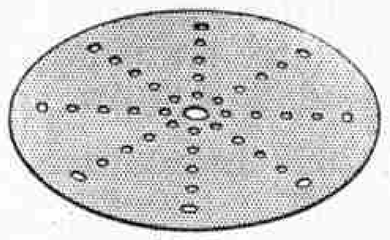
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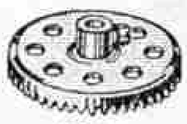
MECCANO ACCESSORY PARTS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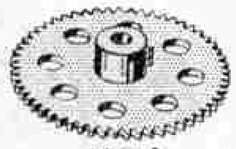
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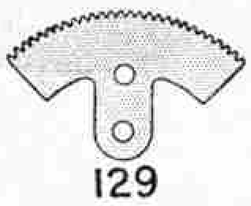
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120A

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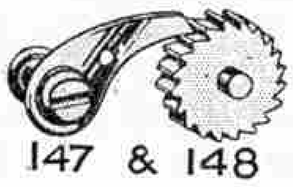
9B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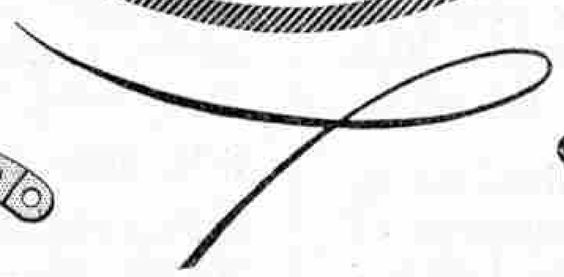

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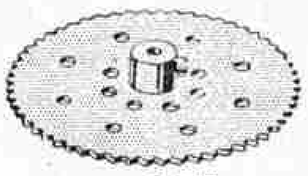
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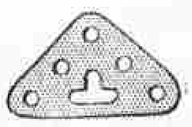
3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90A

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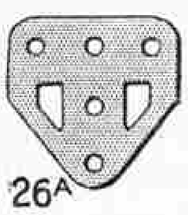
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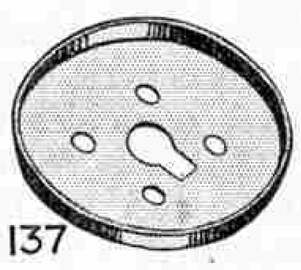
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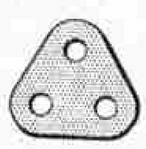
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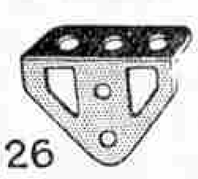
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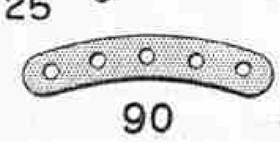
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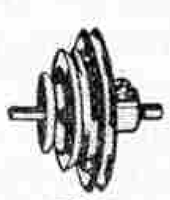
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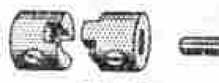
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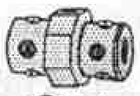
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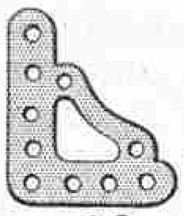
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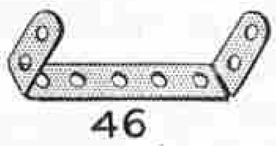
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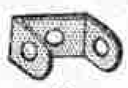
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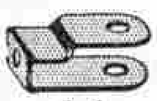
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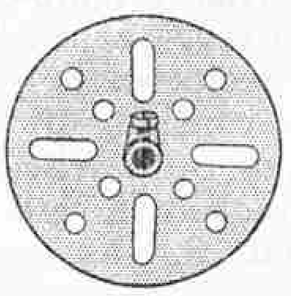
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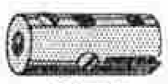
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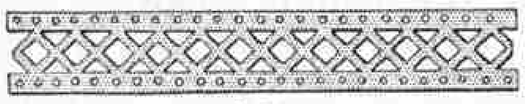
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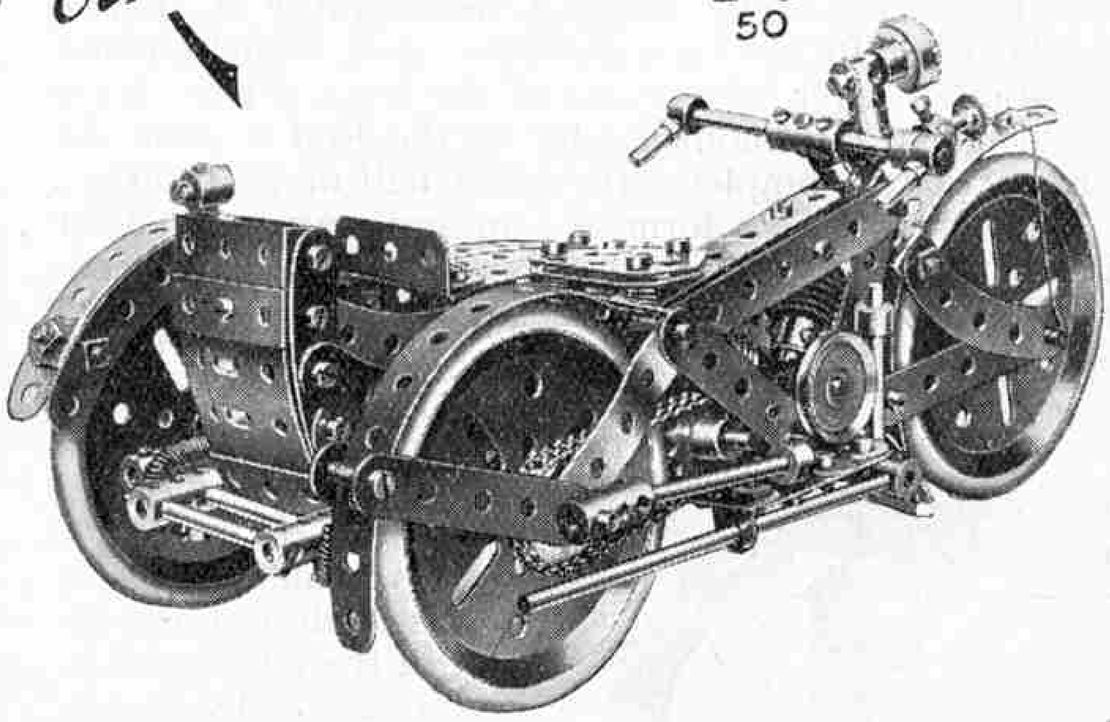
REAL ENGINEERING PARTS IN MINIATURE

Meccano parts, a number of which are here illustrated, combine to form a complete miniature engineering system with which practically any movement known in mechanics may be duplicated.

This year Meccano has an additional attraction—the Plates, Braced Girders, etc., are beautifully enamelled in bright colours. Thus not only is it now possible for you accurately to reproduce big engineering structures in model form, but you can also satisfy your artistic taste and introduce colour into your new Meccano models

Build this fine model and hundreds of others



Price List of Parts Illustrated:

Part No.				
3.	3½″	–	½ doz.	4d.
9b.	3½″	–	„	8d.
11.	–	–	each	1d.
12.	½″×½″	–	doz.	6d.
12a.	1″×1″	–	each	1d.
17.	2″	–	„	1d.
19.	–	–	„	3d.
19c.	6″ diam.	–	„	2/6
20a.	2″	–	„	6d.
21.	1½″	–	„	6d.
22.	1″	–	„	4d.
22a.	1″ loose	–	„	2d.
23.	½″	„	„	6d.
24.	–	–	„	4d.
26.	½″	–	„	4d.
27.	50 teeth	–	„	9d.
27a.	57	„	„	9d.
28.	1½″ diam.	–	„	9d.
30.	–	–	„	10d.
43.	–	–	„	2d.
44.	–	–	„	1d.
45.	–	–	„	1d.
46.	2½″×1″		½ doz.	6d.
50.	–	–	each	2d.

Part No.				
59.	–	–	each	2d.
62.	–	–	„	3d.
63.	–	–	„	6d.
63a.	–	–	„	8d.
63b.	–	–	„	8d.
63c.	–	–	„	6d.
64.	–	–	„	2d.
77.	–	–	„	1d.
80a.	3½″	–	„	3d.
90.	2½″ large radius		„	1d.
90a.	2½″ small radius		„	1d.
94.	40″ length		„	6d.
95b.	3″	...	„	6d.
96.	1″	...	„	3d.
99.	12½″		½ doz.	1/9
103d.	3½″	...	„	7d.
108.	–	–	each	2d.
109.	2½″ diam.		„	4d.
116.	–	–	„	3d.
120.	–	–	„	2d.
120a.	–	–	pair	8d.
123.	–	–	each	1/3

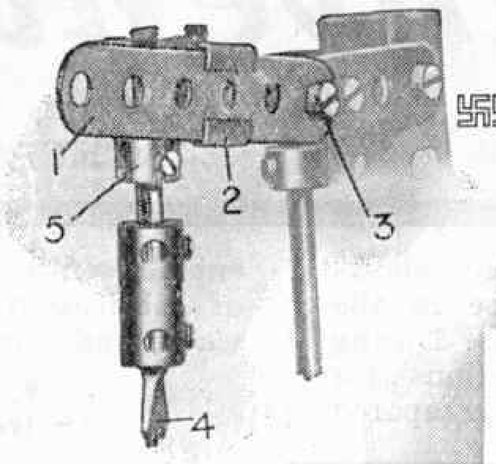
Part No.				
125.	½″		½ doz.	6d.
126.	–	–	each	3d.
126a.	–	–	„	2d.
127.	–	–	„	3d.
128.	–	–	„	4d.
129.	3″ diam.		„	6d.
132.	2¾″	„	– „	2/3
133.	–	–	„	3d.
136.	–	–	„	3d.
137.	–	–	„	4d.
139.	–	–	„	2d.
140.	–	–	„	9d.
143.	5½″ diam.		„	1/–
144.	–	–	„	6d.
146.	6″ diam.		„	1/3
147.	–	–	„	3d.
148.	–	–	„	9d.

ASK YOUR DEALER TO SHOW YOU SAMPLES

Standard Mechanisms, Section XIII.—(*continued from page* 157)

VARIABLE AND MULTIPLE DRIVING MECHANISM

When it is required in actual practice to arrange a shaft so that it may be moved longitudinally whilst being rotated from a fixed driving point, the necessary adjustment is obtained usually by employing squared or splined shafting threaded through the driving pulley or gear wheel. Such a method does not lend itself readily to the Meccano system, for obvious reasons, and the following Standard Mechanism illustrates a simple device by which the required results can be obtained.



S.M. 270a

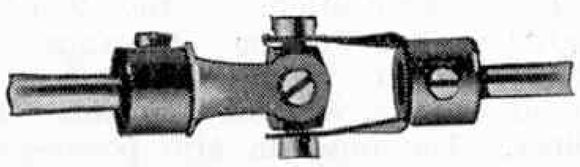
S.M. 270—Variable Rotary Drive

S.M. 270 shows a portion of a Meccano drilling machine, in which it is required to lower the drill into contact with the work and raise it again without stopping the motion of the machine.

It will be noticed that the vertical drill shaft is in two sections, the upper driven section 10 being connected to the lower section by means of a Bush Wheel 1 engaging two short Rods 2 mounted in another Bush Wheel 3, which is secured to the lower section 4. The drilling tool carried on the latter is applied to the work on pressing a lever 5, and on release is returned to its former position by the compression spring 7, which is mounted on the shaft 4 between a Collar 6 and the Double Angle Strip forming the bearing 8. A suitable spring for the purpose is supplied in the Meccano Spring Buffer (Part No. 120a); the spring should be slightly stretched before being used in this apparatus.

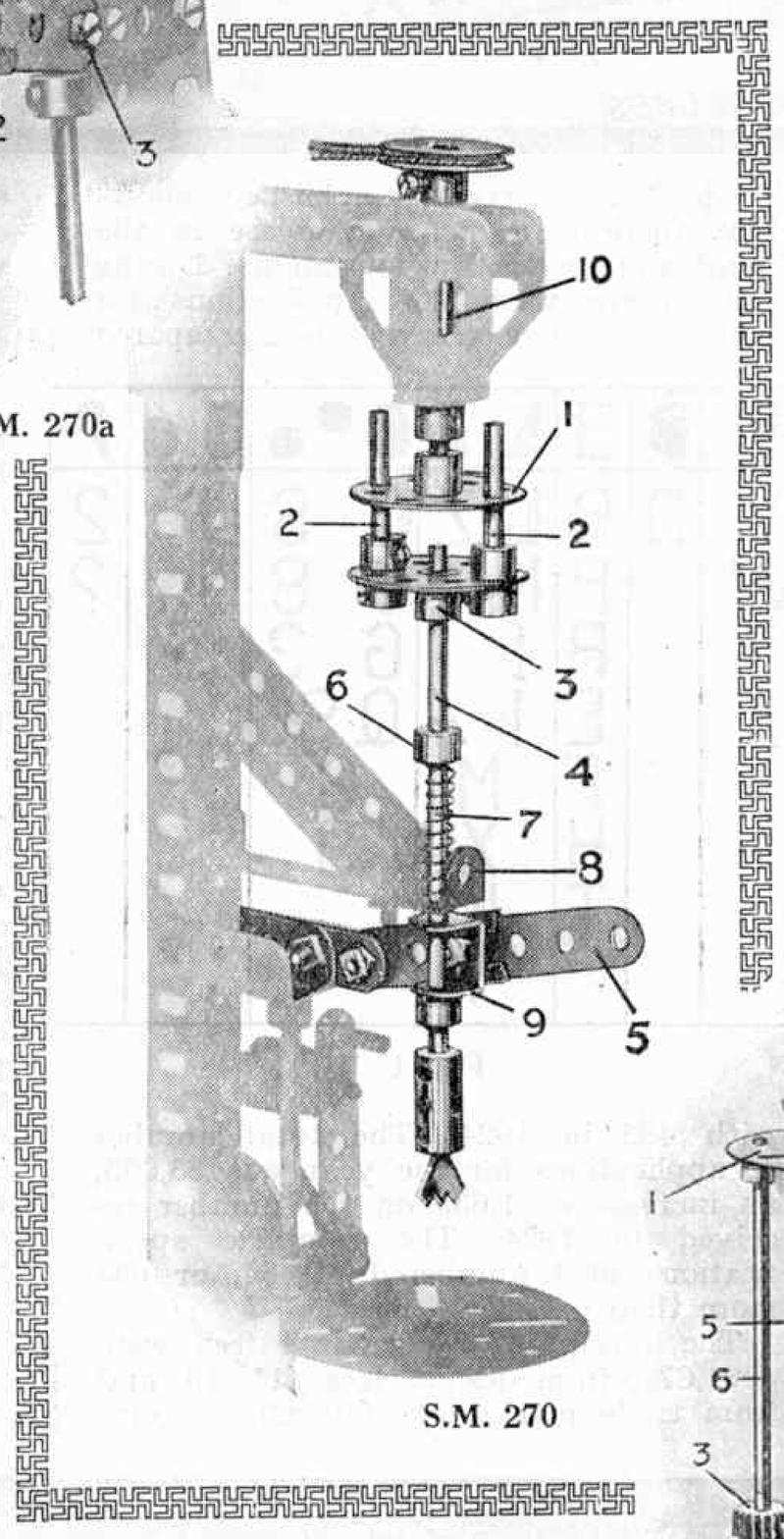
The short Rods 2 adjust themselves to the movement of the drill by sliding in the holes of the Bush Wheel 1, with the result that the lower section 4 remains in gear with the driven shaft 10 throughout its vertical movement.

This type of longitudinal adjustment may also be adapted with good results to certain forms of speed-changing mechanism. In such cases the movable portion of the driving shaft, corresponding to Rod 4 in the illustration, should carry a number of gears of varying sizes, which may be thrown in or out of engagement with corresponding gears on a secondary shaft. Hence the speed of the latter may be varied as desired without affecting the position or operation of the primary or non-slidable portion of the driving shaft.



S.M. 272

S.M. 270a is another view of the drill-adjusting device. The lever 1 is mounted pivotally at 3 by means of bolt and lock-nuts (see S.M. 263) and engages with the Eye Piece 2. The latter is connected—also by bolt and lock-nuts—to a Double Bracket 9 (S.M. 270) mounted on the drill shaft 4.

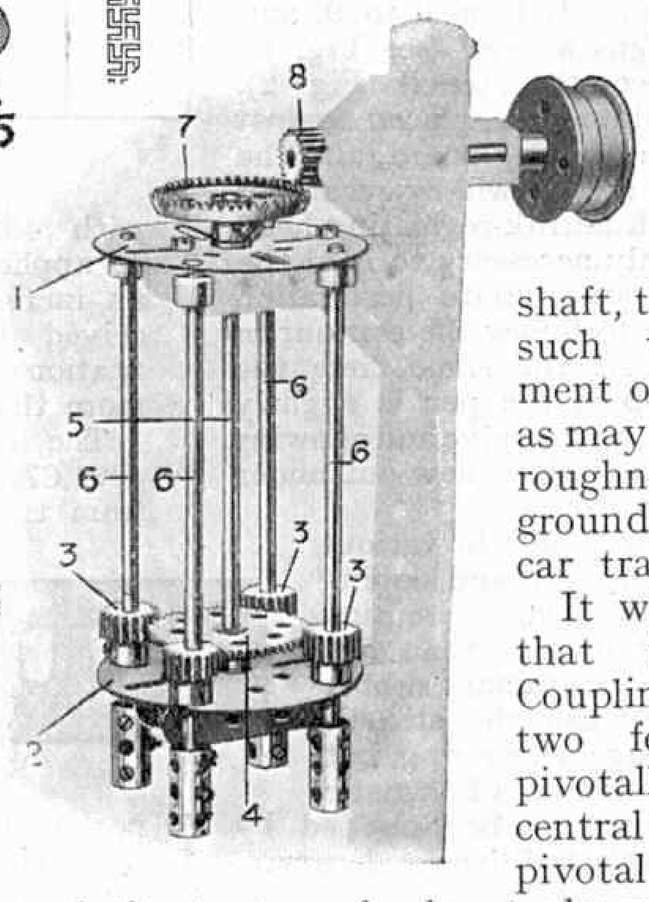


S.M. 270

S.M. 271—Multiple-Drive Mechanism

This mechanism is frequently employed in multiple drilling machines and similar apparatus where several shafts are required to rotate at a uniform speed and in the same direction.

A vertical Rod 5 carries a 1½" Contrate Wheel 7, which is driven by the ½" Pinion 8 secured to the belt pulley shaft. The Rod 5 is journalled through the bosses of two Face Plates 1 and 2, bolted to the upright column of the machine, and carries a 57-teeth Gear Wheel 4. The latter drives ½" Pinions 3 secured to the four countershafts 6, which carry the tools mounted in Couplings on their lower ends.



S.M. 271

S.M. 272—Universal Joint

The Meccano Universal Coupling, or universal joint (part No. 140), is designed to connect two rotating shafts lying in different planes, or meeting at a varying angle. An example of the universal joint is found in all motor cars, where it forms a flexible connection between the propeller shaft and the engine crankshaft, thus allowing for such vertical movement of the back axle as may be set up by the roughness of the ground over which the car travels.

It will be observed that the Universal Coupling consists of two forks or links pivotally attached to a central collar. This pivotal connection permits the shafts to turn freely at almost any angle to each other.

S.M. 273—Speed Indicator

An efficient instrument for measuring the speed of any rotating shaft may be constructed on the centrifugal governor principle (see S.M. 87, Section VI) by employing the movement of the governing weights to actuate a pointer moving over a graduated scale (see Model No. 439, Manual of Instructions).

As the speed of the engine or motor increases, the weights fly out farther from the centre of rotation, and the sliding collar to which they are connected is caused to mount the vertical shaft. This collar is connected to the pointer and the movement of the latter over the dial serves to register the alteration in speed.

An Ingenious Stencil

The lettering of diagrams, drawings and illustrations in general is not an easy process. Many draughtsmen who may be exceedingly good at designing and drawing often fail to annotate, or letter, their drawings, to the same standard—indeed, it is stated to be the exception rather than the rule to find a good draughtsman who is also a good letterer. Now an ingenious stencil, made of transparent celluloid, has been recently placed on the market, however, and with it anyone, whether skilled or otherwise, is able to rapidly execute practically any type of lettering, numerals and signs without any previous experience in draughtsmanship.

The stencil has been so designed that by means of only eleven perforations, it is possible to form all the letters of the alphabet, the numerals from 0 to 9, and about a dozen signs as well (see Fig. 1). To use the device, the stencil (Fig. 2), is held in appropriate clips, placed against a T-square on the drawing board, and the letters or figures are drawn by means of a special pen with an ink-regulating head (Fig. 3). It is only necessary to hold the pen against the appropriate perforation in the stencil and to follow the contour in the usual way. At the same time the button at the top of the pen is slightly depressed thus opening a valve and allowing air to enter and the ink to flow out under the action of gravity.

These stencils are made in various sizes, and both in upright and sloping styles, the complete outfit representing the equivalent of no less than 504 pieces of type of the ordinary rubber type. Not only can the stencils be used for lettering and figuring, but they enable a variety of artistic borders and designs to be obtained by the repetition of selected lines and curves.

* * * *

French Inventions Office

A short time ago the French Government established a National Office of Researches and Inventions, and a large laboratory was founded for the purpose of testing inventions submitted for trial. The 1925 Report has now been issued and shows that during the year 680 new inventions were examined. Only 77 were found to be sufficiently interesting to be referred to the technical committee for further investigation, however, and of these about 50 were found to contain ideas of practical interest.

* * * *

Increase in British Patents

The 43rd report of the comptroller-general of the Patents, Designs and Trade Marks, recently published, shows that there is a steady increase in the number of applications for patents. During 1925 there were 608 applications for patents from women inventors as compared

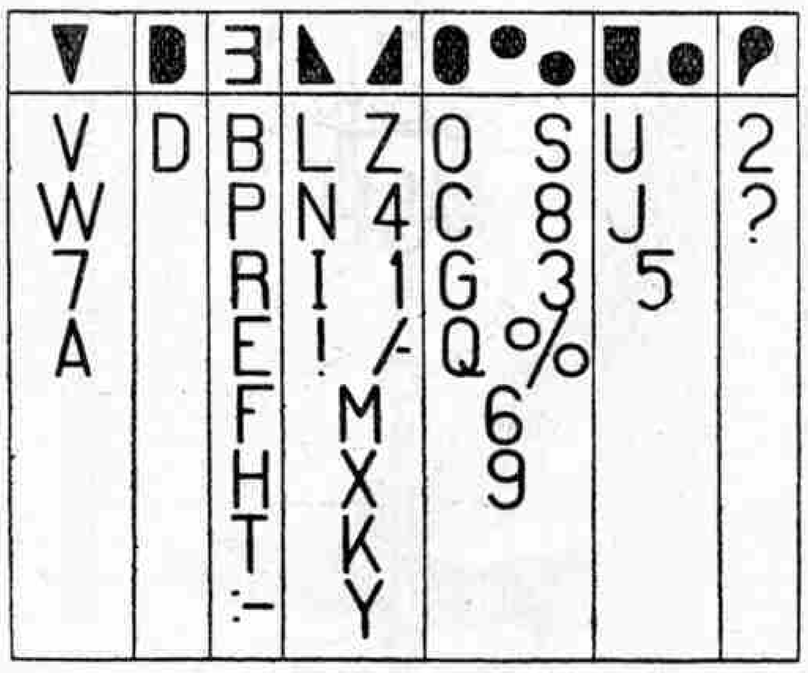


Fig. 1

with 493 in 1924. The total number of applications for the year was 33,003, an increase of 1,633 on the number received in 1924. The complete specifications filed numbered 19,434, or 634 more than in 1924.

The receipts from patents fees were £391,677, from designs fees £11,213, and from trade marks fees £46,960, as compared with £385,592, £11,954 and £49,704 respectively for 1924. The total receipts were £476,044, as compared with £471,154 in 1924. On the expenditure side, salaries amounted to £254,952, as against £251,482 in 1924. The surplus of receipts over expenditure was £88,540.

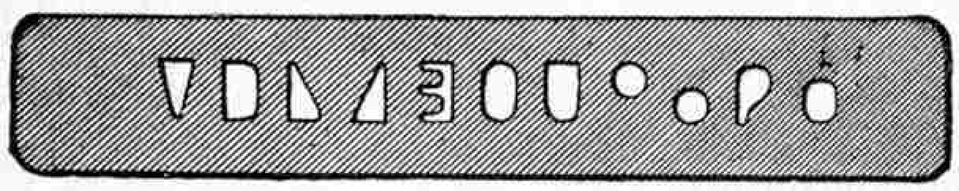


Fig. 2

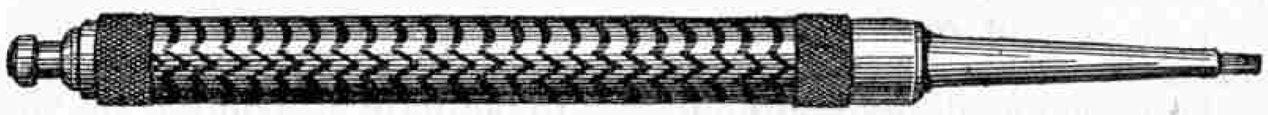


Fig. 3

Acetylene Motor Skates

Skates propelled by acetylene gas have recently been patented by a German engineer. The skates are fitted with two specially constructed cylinders containing sufficient acetylene gas for six hours' continuous running at a mean speed of about 22 miles per hour. The engine is fitted with an automatic system of lubrication and is cooled partly by water and partly by air.

* * * *

An Iron to Rubber Joint

For many years engineers, particularly those associated with the motor industry, have been endeavouring to find a means of making a successful joint of rubber to iron. Until recently the only method of obtaining even a moderately clean job was by partially corrugating the iron or steel surface to which the rubber was to be attached, and curing a hard rubber compound to the steel before applying the softer rubber.

A new process utilises a special product, not unlike liquid cement. This is applied to the metal surface, and compounded rubber is then applied to the "cement" and vulcanised. The result is a perfect joint that is almost unbreakable. In tests, a strip of rubber 1 in. square and 6 in. in length was fastened to a steel beam by this process, and six men were invited to put their full weight on the rubber strip. Their combined efforts failed to tear it adrift! The fact that expansion or contraction of the metal will not affect the joint is one of the principal factors in the success of this process.

* * * *

Inventions Wanted

The booklet entitled "What's Wanted," recently issued by the Institute of Patentees, is specially interesting in view of the International Exhibition of Inventions that opens this month at the Central Hall, Westminster. Nearly 150 different suggestions for required inventions are given and of these the following are among the most interesting:—

Noiseless aeroplane. Aeroplane that can be easily managed by a boy or girl. Noiseless gun. Process to eliminate rust. Transmission of speech by light. Method of conveying speech direct and readably to paper. Pipe that can be easily and effectively cleaned. Electric toaster that will cut off the current before the toast begins to burn. Hatband that does not become discoloured by white streaks after being subjected to heavy rain.

* * * *

First Television Apparatus

The latest acquisition of the South Kensington Science Museum is the apparatus with which Mr. J. L. Baird first experimented in the wireless transmission of outlines. The museum also possesses the first Hughes microphone, Bell's original telephone and Faraday's famous coils.

Electric Paint Burner

Everyone has seen the ordinary type of painters' blow-lamp in operation. These lamps burn petrol or paraffin under air pressure, pumped into the body of the lamp with a plunger. The lamps are used for removing old paint before repainting, and one of their disadvantages is that they sometimes burn the wood work and therefore detract from its enduring qualities. Prolonged application of the lamp also spoils the texture of the surface of the wood and affects its strength, and there is always the risk of fire. All these disadvantages will be done away with, if the claims of the inventor of the new electric paint burner are substantiated.

In the accompanying illustration we show two views of the invention, the heating element of which is arranged in a rectangular frame mounted on a handle, through which the wires pass and make contact with the electric main of the house at which the work is being done. A self-contained switch is fitted into the handle and is operated by the painter's little finger. In one type of burner the upper part of the frame is fitted with a scraper so that paint is removed as soon as it is softened by the heat of the lamp, but when using a lamp of the ordinary type a hand scraper is employed. An advantage of the electric burner is that the heating elements are designed to give even temperatures that will remove all kinds of paint effectively, and will not scorch the wood.

The only apparent serious disadvantage about the new lamp is that it cannot be employed universally, for obviously it can only be used at houses and places of business where electric current is available. Another disadvantage is that the house-holder would no doubt be expected to pay for the current consumed, and if a large number of lamps were employed this might be a somewhat heavy item, of which the house-holder would be relieved if the ordinary petrol-burning lamp were used.

* * * *

Wanted—Unbreakable "China"

Catering companies in this country are awaiting with interest the results of experiments now being carried out in America to produce unbreakable china. Every catering company has an enormous yearly bill for china and earthenware and only when an unbreakable china cup is invented will these great bills be reduced.

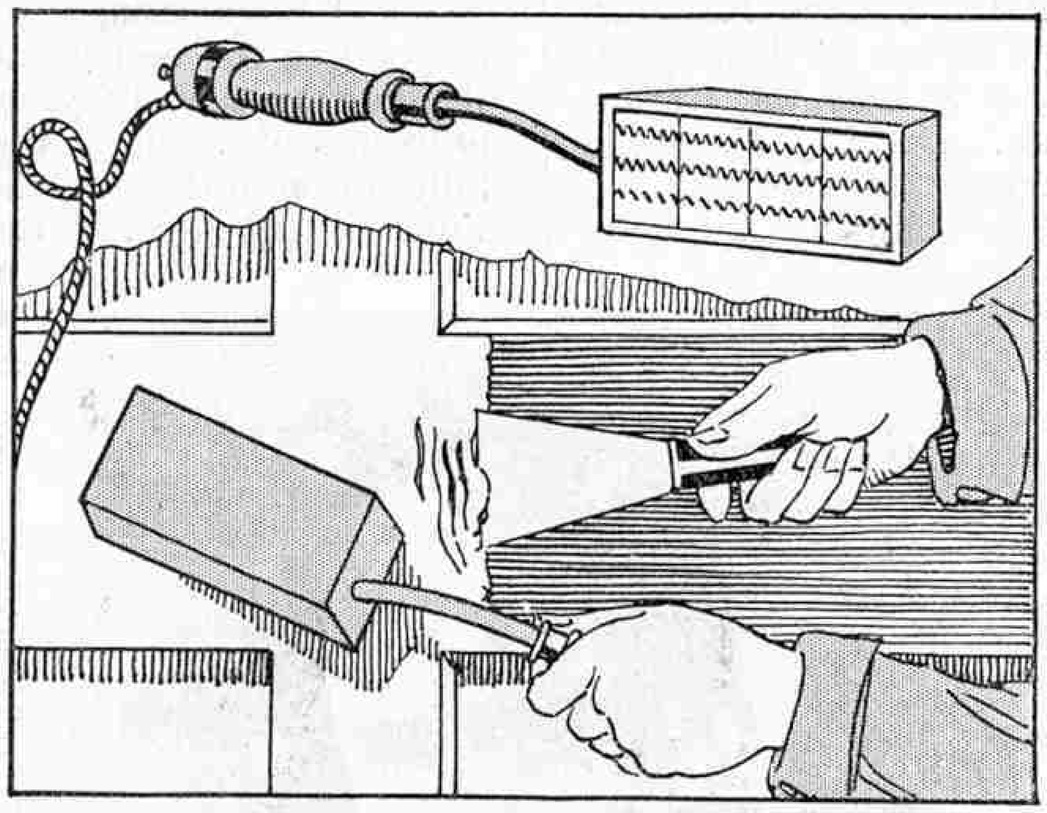
Some idea of the economy that would be effected by the introduction of unbreakable china is gained from the fact that every week the following pieces of crockery are renewed by the A.B.C. Co. (the London caterers) alone :—8,600 cups, 3,600 saucers, 2,200 plates, 1,600 jugs, 1,100 teapots. In addition hundreds of basins, dishes, bowls, and pots of every kind have to be renewed every week. Since January of last year, over 10,000,000 pieces of china and earthenware have been bought by the A.B.C. Company for service in its London restaurants.

* * * *

To prevent the deterioration of tennis balls while held in sports dealers' stocks, the balls are now being stored in steel cans that maintain an air pressure of 20 lb. per square inch.

New Diving Suit

A deep-sea diving suit, made entirely of rustless steel and invented by Mr. J. S. Peress, of Byfleet, differs from a similar German apparatus in that it is jointed so that the diver is able to move hands, arms, or legs. The joints, which are hydraulically controlled and are unaffected by pressure of water, are watertight even without an inner suit. The armour is made up of over fifty pieces and weighs 550 lb. It has not yet been tried in the sea, but the inventor declares that it has been "found to work satisfactorily" at a depth of 650 ft.



The Electrically-heated Paint Burner

Unlike the German model used in the attempt to locate the submarine *M.1*, the suit is not self-contained for breathing. An air-pipe is fitted, but a breathing apparatus in the helmet for deep diving could be supplied.

The Peress suit has delicately constructed mechanical hands, and the diver, when submerged, can change these hands for powerful tools for dealing with wrecks.

* * * *

An Almost Human Clock

A remarkable clock has been invented by an optician as a development of an apparatus that he made many years ago to control the lights of a flashing sign placed outside his shop. This ingenious clock is operated by electricity and can be set to switch on the lights of a motor car at lighting-up time, regardless of the variations in the daily time of sunset. It will switch off lights at daybreak and can be used to control shop window lighting between sunset and dawn. Another feature of the clock is that it tells at what time the sun rose and set on the day of any stated person's birth, and will indicate in advance similar details for any day in the future.

In external appearance the clock does not differ greatly from any other clock, but it has two extremely important small dials. One is for setting the clock at the proper month and day when it is first started, and the other for regulating the hour at which the lights controlled by it are to be turned off. The self-winding apparatus is operated from the ordinary electric main, and if the supply should fail, the inventor claims that the clock will run for a further four days. The only adjustment needed normally is to account for 29th February once every four years.

The Loudest Foghorn

A new type of foghorn known as the diaphone, which has a range of sound of over 40 miles, has been provided for use in the lighthouses controlled by Trinity House. The new instrument is to be fitted in all new structures while the fog signals in other existing stations will be replaced as opportunity serves.

The diaphone originally was invented as a musical instrument, but although a complete diaphone organ was installed in a London picture house it did not meet with success in the way the inventor intended. The patent was developed in Canada and America for use as a marine fog-signal and its vibratory power is considerably greater than that of any other similar instrument. It is employed at all the lighthouses on the North American coasts which include some of the most fog-bound districts in the world.

* * * *

Who Invented the Free-Wheel

From a book published in 1869, it would appear that the invention of the free wheel is of earlier date than is generally supposed. This book, by "Velox" of Leamington, deals with velocipede construction and describes and illustrates a free-wheel.

After giving instructions how to fix the axle to the wooden "nave" of the front wheel, the writer goes on to say :—"Another plan may be followed which has many advantages. The wheel may be left free on the axle, as in an ordinary carriage, and on the outside of the nave a strong iron plate may be screwed, working with a ratchet catch. The crank arm will then run free when descending an incline. This modification is far better adapted for a treadle bicycle than for a tricycle, and can only be recommended when the nave of the wheel needs strengthening."

* * * *

An Electric Lock

A lock that can be opened only by means of a distant electrical control is an invention of an official of one of the Government offices. It is impossible for a door or window fitted with the electric lock to be opened without raising an alarm. If thieves cut the wire, the lock automatically becomes immovable.

The new lock will no doubt have many applications—used on train doors, for instance, it would ensure that all doors would be kept locked throughout the time of travel, and their opening and locking could be controlled by a single switch in the guard's van.

* * * *

New Source of Pig Iron

A method of extracting a high-grade pig iron from the black sands of the Pacific Coast Islands is at present under trial. An experimental plant at Seattle having proved successful when working the British Columbia black sand, it is proposed to establish a plant at Port Moody, B.C., capable of extracting 30 tons of pig iron per day. Up to the present, the black sand, of which there are huge deposits available, has been solely used for gold-panning, although a certain amount of platinum also has been obtained.

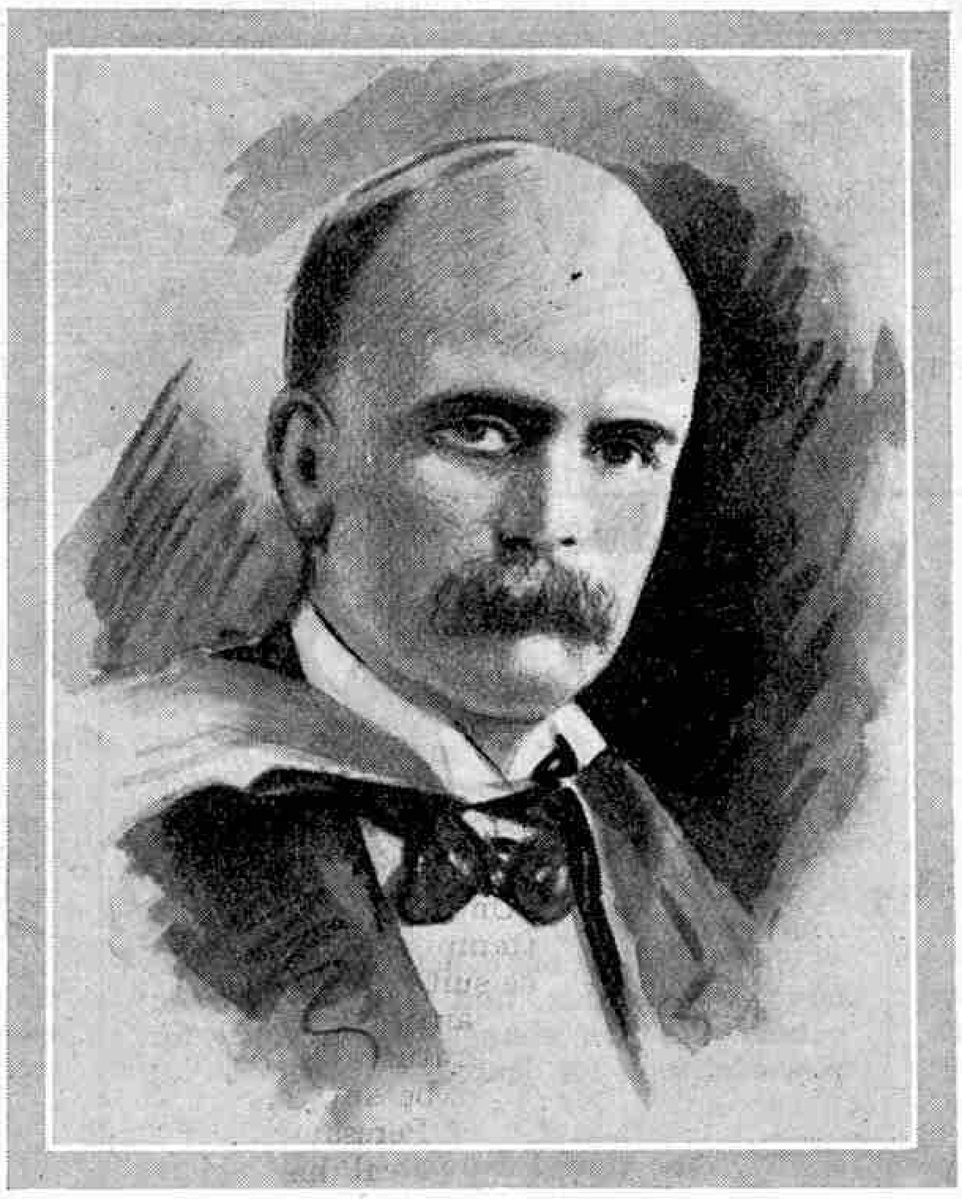
The Man Behind the Sydney Bridge

"With the qualifications of an extraordinarily brilliant imagination, he pictures Sydney as Napoleon did a field of battle"—So said a famous K.C. speaking of Dr. J. J. C. Bradfield at the turning of the first sod of the northern approach to the Sydney Harbour Bridge. Dr. Bradfield planned the bridge and is the engineer in charge of the work on behalf of the Government. This article tells something of this wonderful man and of his early days.

SO much has been written about the Sydney Harbour Bridge and its wonders that we are in danger of overlooking the man to whom is due the credit for planning this mighty structure. Dr. J. J. C. Bradfield, a few years ago chief engineer for the N.S.W. Metropolitan Railway Construction Company but now appointed Government Engineer for the Sydney Harbour Bridge, was born at Sandgate, in Queensland, in December 1867. He was educated at the Ipswich Grammar School (Australia), a school that has turned out many brilliant men. He won several prizes, passed the Sydney Junior exams. and in 1883 won the Chemistry medal.

Two years later he passed the Sydney Senior exams. in the first class and again won the Chemistry medal. During the same year he was Head Boy of the school and won one of the three Queensland scholarships at the University.

In 1886 he matriculated at Sydney University, with honours in mathematics. During his University course in engineering he obtained honours in mathematics, physics, chemistry, mineralogy, architecture, and engineering. He also won scholarships in chemistry and physics, and obtained special distinction in engineering and architecture, finally graduating with first-class honours and the University medal.



Dr. J. J. C. Bradfield

In 1896 he obtained the degree of Master of Engineering with first-class honours, and the University medal. In the same year he passed, with exceptional brilliancy, an examination in connection with which he submitted a thesis on Australian timbers. This was considered to be of such great merit that the Chancellor made special reference to it in his commemoration address.

Success in examinations is not always a sign of success in later life, however, but Dr. Bradfield has been able to combine theory and practice in a remarkably successful degree.

In 1910 the Challis Professor of Engineering said of him that he was "at least as good as the best graduate we have produced during the last twenty-six years." In discussing the traffic problems of Sydney, the Professor said that he was fully in accord with the leading railway experts of England and America that Mr. Bradfield was the best man available in the engineering world capable of solving Sydney's complex transit problems.

During his term in the Public Service of New South Wales Dr. Bradfield was responsible for the design of many works of great importance, including the Cataract Dam, which cost £357,500; the Burinjuck Dam, costing over £1,000,000, and portions of the North Coast railway, costing about £2,000,000.

A short time ago Mr. W. A. Holman, K.C., ex-Premier of New South Wales said that Mr. Bradfield was an honour to the Public Service. "He is one of the three persons in this country," he added, "who are the equals, or the superiors, of their confreres in any part of the world. A born genius, he is in the front rank of the engineers of the world. His skill is unchallengeable. It has run the gauntlet of the world's specialists."

In private life Dr. Bradfield is as modest as he is brilliant. When he visits Ipswich, during his holiday trips to Queensland, he invariably accompanies his mother to church. Few know that the modest gentleman sitting in the family pew at St. Paul's is the brilliant engineer and creator of the design of what is to be one of the world's most famous bridges. He enjoys good health, and it is said that he has never had to consult a doctor or dentist. The great bridge is his hobby and the amount of work that he put into it, added to his perseverance and powerful imagination, accounts for his success. It is pleasing to learn that in his planning for the great project, his wife has always been a sympathetic and enthusiastic helpmate.

The acceptance of the tender for the bridge meant

(I.) The Progress of Sydney Harbour Bridge

The completion of the approach spans. Staging for Main Span "creeper cranes" being erected on north and south sides by 25-ton cranes

only a comparative respite for Dr. Bradfield, who continues to carry out a great deal of work in supervising the construction for the Government.

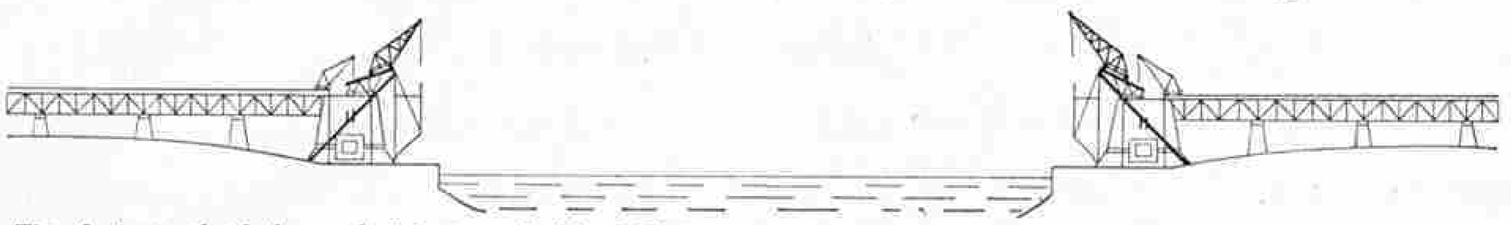
When the word holiday was mentioned to him a short time ago, Dr. Bradfield laughed!

"You will be having a nervous breakdown if you don't take some rest," he was assured, at which he roared.

"I don't go in for those kind of things," he said. "I am not the sort." He is not that sort for he thrives on hard work, and has no nerves.

A short time ago Dr. Bradfield was over in England and gave an interesting lecture delivered to the Cleveland Institution of Engineers, Middlesbrough—in which town is located Dorman, Long & Co. Ltd., the contractors who are building the bridge. Dr. Bradfield confidently anticipates that this immense arch bridge, with its span of 1,650 ft. and its 50,300 tons of steelwork, will be completed in 1931, and that in the first year a profit of a quarter of a million sterling will result from it.

(II.) The Progress of Sydney Harbour Bridge



The first panel of the arch being erected by 120-ton creeper cranes. Note the first anchorages from the top of the end posts. (Further progress will be illustrated in future issues)

At his lecture Dr. Bradfield referred jocularly to the odd shillings and pence in the contract price (£4,217,021 11s. 10d.) and confessed himself unable to imagine what they attempted to represent. He ventured the pious opinion that so significant an excess on round figures must surely be the contractors' profit. In replying, Sir Hugh Bell, a director of Dorman, Long & Co. Ltd., was able to throw a little light on this debatable subject. "We did not want an inflated profit," he said, "so we knocked off three-farthings!"

Saving Sixteen Days—(*continued from page* 130)

in the Egypt-India air-route will be by the P. and O. steamer to Port Said, and the new service connects with the sailings between Marseilles and this place. By using the air-service a passenger from England will be able to make the quickest possible journey to such places as Baghdad, Basra, and India, and as compared with a voyage via Bombay will save sixteen days. In a journey to Basra the saving of time effected will be fourteen days. In addition to speeding up passenger travel and the mails, the new air-service will enable army officers in India to lengthen their period of leave at home by some weeks.

At first the service will run fortnightly and will work approximately to the time table shown on the previous page. Later the service may be weekly, leaving Cairo every Wednesday, the departure coinciding with the arrival of the P. and O. mail boat from England.

The arrival at Baghdad and Basra will take place on the following afternoon, and at this latter place the passengers will be transferred to another aeroplane. This machine will fly every Thursday across the Persian Gulf to Karachi, arriving there on Saturday in time to catch the Trans-Indian train to Delhi and Calcutta. The return journey will be from Karachi the following Thursday, arriving at Baghdad on Saturday, and at Cairo on Sunday in time to connect with the mail boat for Marseilles.

Although the time taken for the complete flight will be just over three days, the actual flying time eastward is only 29 hours, whereas flying westward it is 37 hours. The difference in the times is due to the fact that prevailing winds blow from the west, or northwest, with an average velocity of at least 10 to 15 miles per hour. Thus, although the speed eastward is 90 m.p.h. the wind reduces this westward to 70 m.p.h.

At the places where the night is spent are rest houses specially constructed to accommodate the passengers and crew.

It is interesting to learn that the fares will be as follows:—Cairo-Karachi, £72. Cairo-Baghdad, £41. Cairo-Basra, £51. Baghdad-Karachi, £37. Basra-Karachi, £30. Baghdad-Basra, £9.

With the inauguration of the Cairo-Karachi service nearly two-thirds of the England to India air-route is in operation. The distance from London to Karachi is roughly 5,500 miles, and of this the new line from Cairo to Karachi is 2,536 miles in length. This distance is further reduced by the regular service between London and Basel, a distance of over 500 miles, thus making a total of 3,000 miles of organised air-lines out of the 5,500 miles that separate London from Karachi.

As regards the first link in the chain, that between England and Cairo, alternative services are now under consideration—one direct to Cairo through France, another through Italy, and a third through Cologne, Bucharest, and Constantinople.

Already plans are in hand for extending the route beyond Karachi and it is hoped that, with another day's flying, it will be possible to reach Delhi. Later the service may be extended even further—to Calcutta, Rangoon, Singapore, and the Dutch East Indies, where contact may be made with an Australian Service flying from Port Darwin. When—and if—this comes to pass, the chain, as mapped out by Sir Alan Cobham in his flight from England to Australia, would be complete.

In this connection it is encouraging to learn of the official assistance given to civil aviation, for the Imperial Airways have entered into an agreement with the Government to run the air-service from Cairo to Karachi for a period of five years, Imperial Airways to receive a subsidy of some £90,000 a year.

The maximum annual subsidy that can be earned is £93,600 and should that be earned in full in each of the five years, and should the cost of the ground organisation (that the Air Ministry has undertaken to arrange at a number of places on the route) reach the estimate of about £65,000, the total cost of the scheme would be slightly over £500,000. Any profit on the working of the service will go to repaying the Government subsidies.

The institution of the Cairo-Karachi service will make it possible to terminate the fortnightly mail service between Egypt and Iraq, hitherto performed by the Royal Air Force. It has been arranged to withdraw from Iraq a squadron of the Royal Air Force, so that a substantial economy should result to the tax-payer.

Even with Government subsidies progress in forming new air-routes, or in extending existing services is necessarily slow, for there are many difficulties to be overcome, especially where the routes concerned are in the east. On the Cairo-Karachi route, for instance, as the traveller goes eastward, a certain amount of daylight is lost, and in going westward the reverse is the case. The apparent effect, judged by local time, is that the journey from Cairo to Karachi takes considerably longer than the journey in the reverse direction, although the actual flying time may be exactly the same.

This factor affects the question of night flying, of course, and more particularly so on this route, where day and night are more equal throughout the year, so that flights cannot be made as late in the evening as is possible in Europe during the summer. In Egypt the sun rises at 7 a.m. during the shortest days and sets at 5 p.m. On the longest days it rises at 5 a.m. and sets at 7 p.m., with only half-an-hour of twilight.

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The Forenoon Watch

In the Engine-Room of a Tramp Steamer

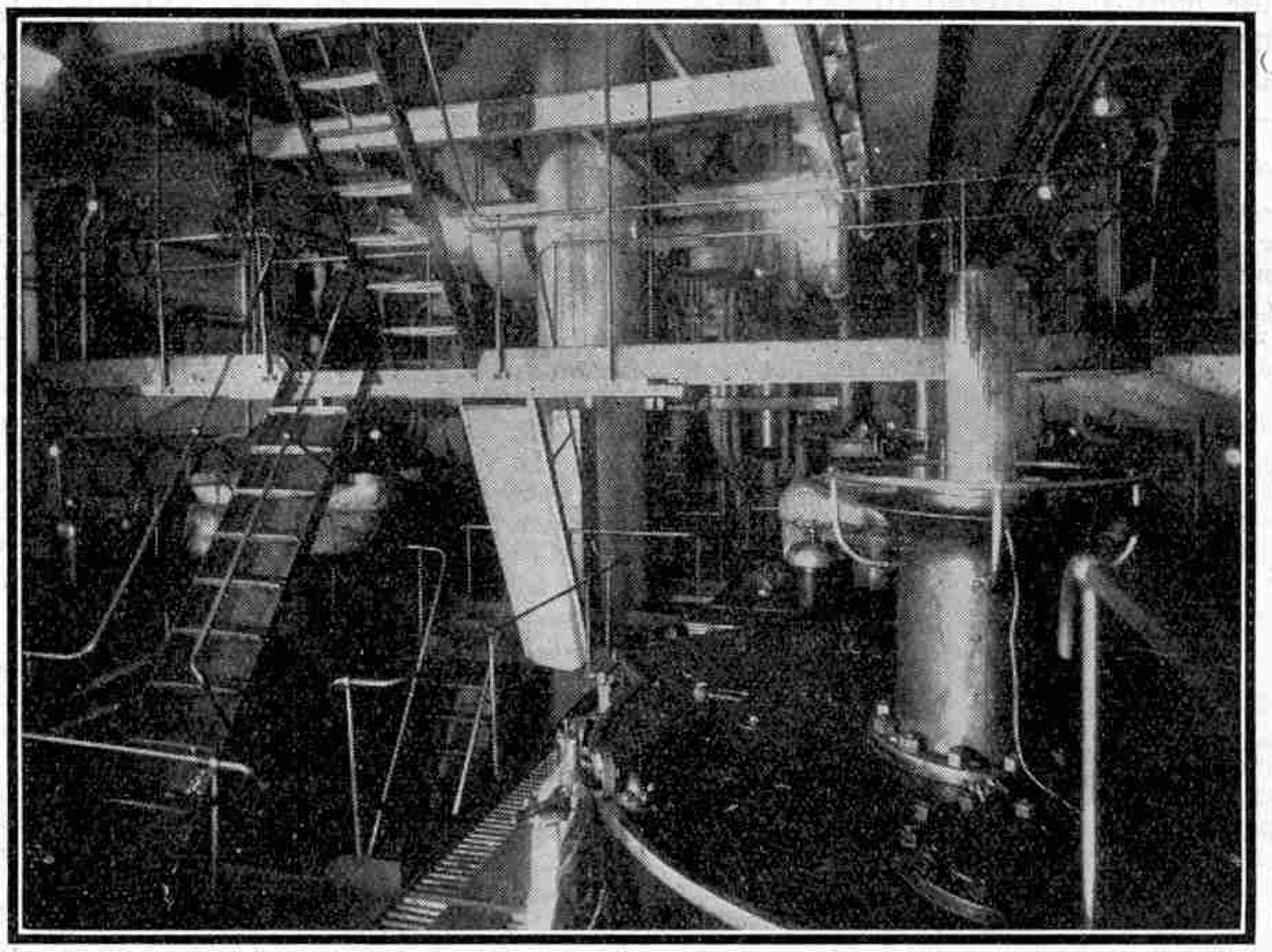
By "Fourth Engineer"

THE "Fourth" dashes down the engine-room steps as eight bells are being struck on the bridge.

The "Second" gazes at the clock, which points to ten minutes past eight. "Your watch starts at 8 o'clock, not ten minutes past," is his gruff greeting.

"It has only just struck eight bells on deck," answers the "Fourth," and then the "Second" remembers that they are going "out West," and that the local time becomes four minutes earlier for every degree of longitude.

The "Fourth" proceeds to feel the engines, commencing with the low pressure bottom-end. Catching the crank as it comes over the top centre, he feels the brasses in order to find out if they are running hot. Being assured that they are all at the right temperature, he transfers his hand to the top-end brasses, and again the result satisfies him. This procedure is repeated on the intermediate and high pressure engines, main bearings, link gear and eccentric straps. Everything is satisfactory. A glance at the water gauges on the boilers, a quick look in the bilges, and a feel at the pump-rod drives at the back of the condenser complete his tour of inspection.



In the Engine Room of the White Star Liner "*Homeric*," showing cylinder tops and ascent ladders

"Righto 'Second,'" is his assurance to the second engineer as the latter makes his way to the steps.

Half-way up the steps the "Second" turns and shouts: "Watch the 'vap,' she's likely to prime."

By "vap" the "Second" means the evaporator, the function of which is to eliminate brine from the salt water and pass it on in as fresh a condition as possible to the boilers, via the feed-pumps. Priming is the term used to denote that the evaporator drain-pipe is choked by the residue from the salt water.

The "Fourth" nods his head and contemplates having a "soft watch." He decides to have a look down the shaft tunnel and, making his way along with a "duck lamp," he feels each bearing. A glance down the after-well and a look at the stern-gland satisfy him that no more water is running into the after-well than the pumps are capable of dealing with.

His arrival back at the engine-room platform coincides with the time for oiling. Taking his oil-can he first oils the main bearings and eccentric straps. He then climbs up to the grating that gives him access to the oil-pipes leading to the connecting-rod brasses, link gear and pump-rod drives. After giving these the prescribed amount of oil he makes his way to the feed-pump checks and adjusts the valves so that each boiler is securing an equal share of water. Setting down his oil-can he picks up the swab-brush and swabs the rods, which operation consists of applying black oil with a short brush to the piston-rods and valve-rods. This calls for watchfulness and dexterity. The slightest inattention and—well, the "Second" doesn't half growl when you ask him for a new brush!

These little jobs done, the "Fourth" takes his stand facing the engines with his back to the spare bunker and, after a quick glance up the steps to see if the "Chief" is about, quickly rolls a "fag" and lights up. Having finished his smoke he goes round the back of the engines and inspects the evaporator. It is now time for another oil round, and he repeats the operations just described, subsequently proceeding to the evaporator to adjust the "blow-down" in order that the sediment from the water shall be blown away to the bilges.

Making his way to the front platform, the "Fourth" feels that that side of the ship seems to be down a little. With a look of annoyance he takes a duck lamp and, lifting a trap-door in the platform, makes his way on to the tank tops. On reaching the bilge his fears are realised—it is full to the top. With a growl he goes to the bench and secures a spanner and climbs down to the valve on the tank tops. Taking the valve to pieces he finds, just as he had expected, a piece of rubbish under the valve, preventing it from shutting and so destroying the vacuum in the pipe-line that is necessary for the pumps to function properly. He removes the obstruction and reassembles the valve, hoping that his

efforts will be successful. Ten minutes later he again goes under the platform and notes with satisfaction that the water in the bilge is decreasing. On return to the platform he finds that it is time to oil round again.

The watch is getting on. Another "fag" after oiling, and then a climb of thirty-odd steps in order to reach the steering engine, which also he proceeds to oil thoroughly. On reaching the platform he decides to take a walk to the port bilge and to his dismay he finds that there is more water there than there should be. He tackles this trouble as he previously dealt with the starboard bilge, but in this case he finds no obstruction to restrict the operation of the valve. With a "fed-up" expression on his face he reassembles the valve. Standing up and scratching his head he contemplates groping amidst the "bilge juice" in order to find out if the rose-boxes around the suction pipe are choked. He comes to the conclusion that it will have to be done, and with a sigh he rolls up his sleeve as far as it will go and plunges his arm down in the direction of the pipe. With a sickly look on his face he withdraws his arm and places on the platform a choice collection of ashes, grease and slime of a description that can only be found in ships' bilges. The removal of this rubbish coincides with a gradual lessening of the water, to his great satisfaction.

Time to oil round again!

"Oh, it's a soft watch alright," thinks the "Fourth." "Life on a farm would be a treat."

He finishes his oiling and is beginning to feel cheerful at the approaching end of his watch when a weird, tearing kind of noise causes him to dash round behind the engines. The evaporator is priming! He shuts off the water supply and then climbs to the top grating to shut the valve that supplies steam to the evaporator. Wearily he climbs down to the platform. Lying full length beneath the evaporator he loosens the bolts on the drain pipe and, taking a rod, rams it in the blow-down drain to loosen the brine that has collected round the hole, thus preventing surplus water from getting away. By the time that he has re-joined the pipe he is like a wet rag through the terrible heat.

Time to oil round again. This completed, he has another smoke, and tells himself what a good soft afternoon he'll have and what a good time he'll have in port. Only another quarter of an hour to go and then the "Third" will relieve him. Thank heaven nothing much more can occur in a quarter of an hour.

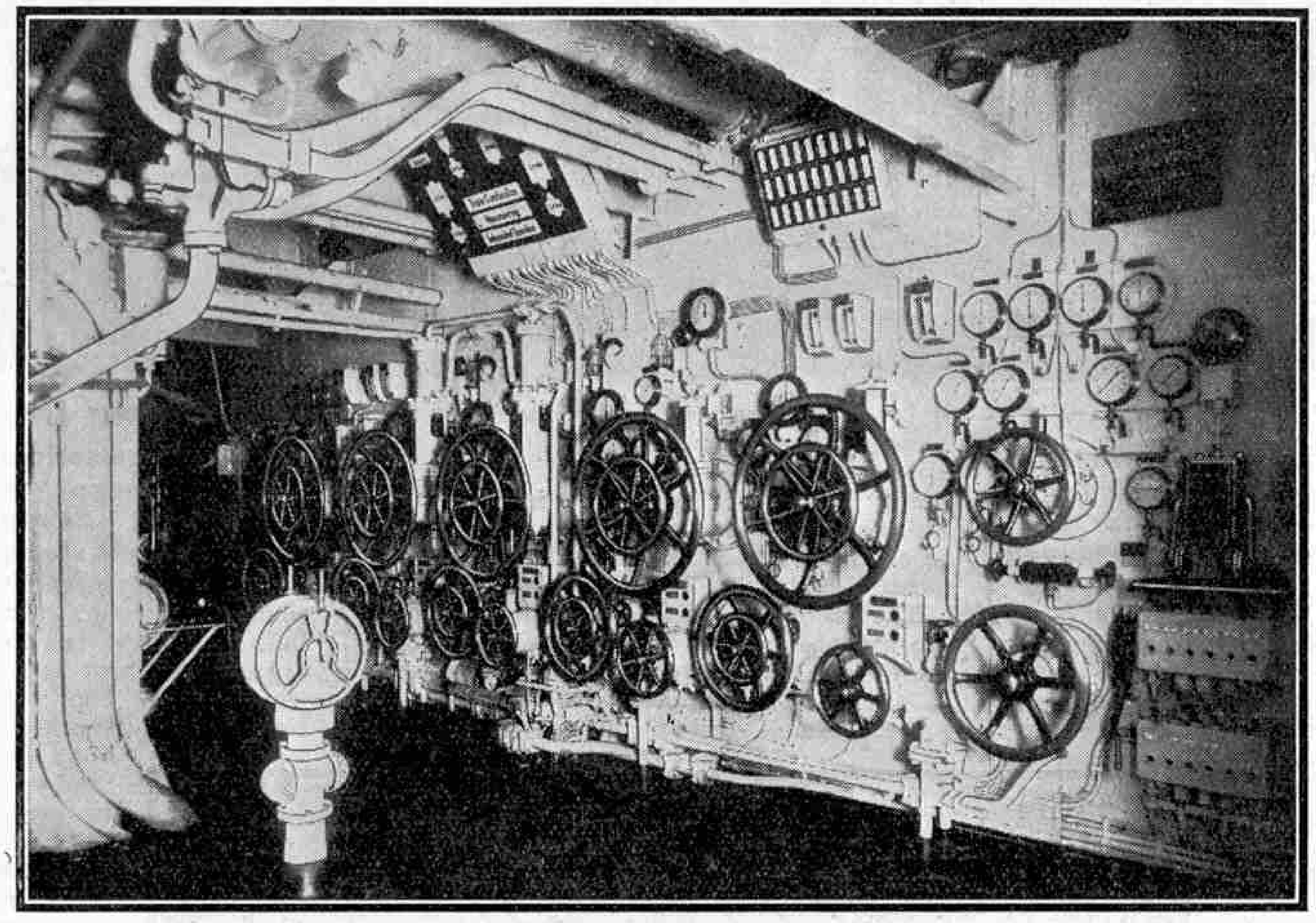
Bang!!!!! A gauge glass on the boiler has burst!

The "Fourth," all his pleasant dreams rudely dissipated, dives for a sack and throwing it over his head to protect his eyes rushes up the ladder. Amid a cloud of steam he manages to close the steam and water ends of the gauges. He puts in a new glass and is just tightening up the last nut when he sees the "Third" coming down to relieve him.

The "Fourth" greets the "Third" with his tale of the trials and troubles that have occurred on his watch and, when the "Third" has "felt round" and accepted the engines as correct, he wearily makes his way out of the engine-room to the mess-room and attacks his dinner. Afterwards he tells the "Chief" about his watch and finishes by remarking that he'll have an easy afternoon in his bunk. He is just going for a bath when the "Second" spys him.

"Hey 'Fourth,'" yells the "Second," "take a spanner and go round the winches on the fore-deck, they want attending to."

Visions of a cosy afternoon fade away and with a groan the "Fourth" murmurs: "Good Lor', another field day—fancy overhauling auxiliary machinery after finishing a watch!"



The Starting Platform in the Engine Room on board the White Star "Majestic," the World's Largest Liner (56,551 tons)

Result of Drawing Contest

We are informed that the Drawing Contest announced in our December issue has met with an exceptionally large response. The entries themselves included some excellent work, and several competitors sent in additional drawings, coloured or embellished in some other way. We have pleasure in announcing the names of the prize-winners below, and the prizes have been despatched to these entrants.

CORRECT SOLUTION

1st Prize—New Meccano No. 6 Outfit in colours (value £5-5s.-0d.) K. L. W. COOK, 3b, Weyhill Road, ANDOVER.

2nd Prize—New Meccano No. 5 Outfit in colours (value £2-15s.-0d.) G. F. ROBERTS, 13, Oakland Villas, Reynoldson Street, Newland, HULL.

3rd Prize—New Meccano No. 3 Outfit in colours (value £1-2s.-6d.) A. W. G. GREEN, Robertson Place, MILLIKEN PARK, Renfrewshire.

The ten Consolation Prizes, No. 0 New Meccano Outfits (value 5/- each) have been awarded as follows:—

ROBERT NISBET, 110, Lennox St., Possilpark, GLASGOW. ERIC W. WHITE, 29a, Essex Road, Islington, LONDON, N.1. THOS. O. DAWSON, 34, Crawford Avenue, Tyldesley, MANCHESTER. T. COKER, R.S.B. Hospital, Lettsom Ward, MARGATE, WEST. HAROLD JACKSON, 68, Bedford St., Moss Side, MANCHESTER. JACK SOBEY, 36, Graham Road, Pendleton, MANCHESTER. G. MARCUS BOYES, 2, Cambridge Road, Lee, LONDON, S.E.12. WILLIAM SANDS, 173, Twickenham Road, LEYTONSTONE, E.11. WILLIAM DENIS HARVEY, 159, Ladybridge Road, CHEADLE HULME. JAMES W. MCGREGOR, 9, Carmichael St., Govan, GLASGOW.

NOTES FROM THE ZOO

Eight-Months'-Old Tiger Cub

The latest addition to the lion house is a female tiger-cub only eight months old. This young tigress is about the size of a large dog, and at present is a docile and affectionate creature giving signs of becoming a great pet. The Zoo has had several lion and tiger cubs previously, but as they have grown up they have exceeded the limits of size—and sometimes of temper—required in a domestic pet. This is the case with "Maurice," another young tiger, who is very friendly with his keeper but takes a somewhat sinister interest in visitors!

* * *

Baby Anacondas

Great excitement prevailed at the Zoo on Friday, the 17th December last, when it became known that 39 baby anacondas had been born. Unfortunately, only 18 remain alive, as before they could be removed into safe quarters their mother killed some by lying on them and, sad to relate, swallowed a few more!

The anaconda is a large swimming boa and the present specimen, about 17 ft. in length, was presented by the well-known explorer, Mr. Mitchell Hedges, who caught it during his expedition in search of Maya ruins in Central America. The baby snakes are about 2 ft. in length and have polished brown skins with large black spots. A specially-heated cage containing a pool of water has been made into a home for them and they are already vigorous swimmers. Even at the age of one hour they were very lively and vicious, and showed considerable eagerness to test their sharp, needle-like teeth on the keeper's fingers!

* * * *

Reptiles Literally "Get the Wind Up"

Among the strangest of the most recent arrivals at the Zoo are a snake and a number of tortoises that do literally "get the wind up." These creatures all come from Africa.

The snake is a puff adder and is the largest ever seen at the Zoo. Normally it is as thick as a man's arm, but when alarmed or irritated it inflates itself to nearly twice that size. The air thus taken in is expelled with a hiss like that of steam escaping from a boiler and the performance is certainly calculated to inspire terror in enemies or prospective victims. This the puff adder may well do as it grows to a length of four feet and is one of the most deadly poisonous snakes known.

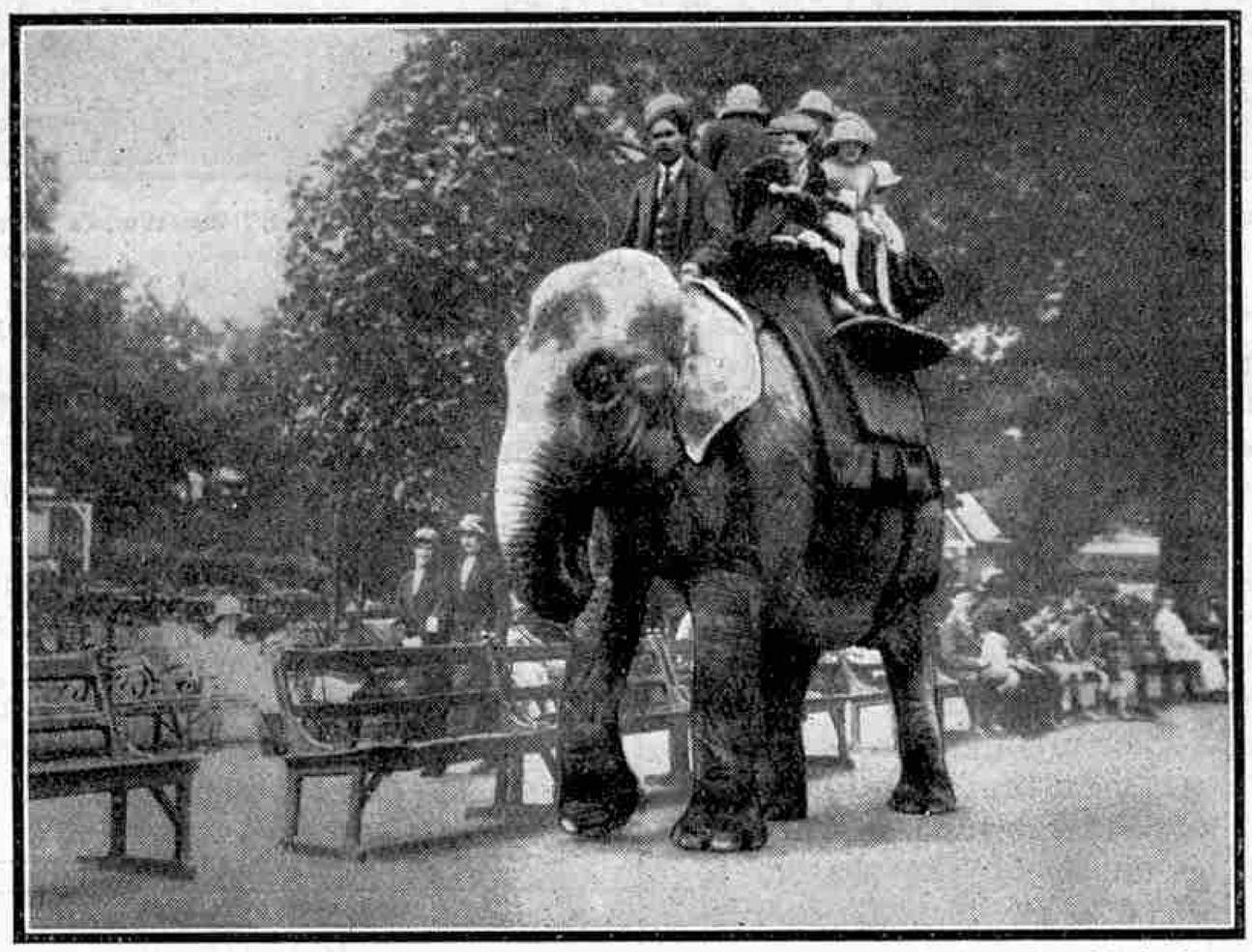
The tortoises, which are 43 in number, are soft-shelled and inoffensive and make use of inflation entirely for self-protection. If one of these creatures is alarmed it squeezes itself through narrow cracks or crevices between rocks or stones, and then proceeds to blow itself out until it is too big to be pulled from its hiding place!

* * *

Crocodiles in Comfort

Among the many important alterations now proceeding at the Zoo is the installation in the crocodile house of heating and lighting apparatus of an entirely new kind. The fortunate "crocs" will soon be able to swim in electrically-heated water and lie on electrically-heated sand, basking in the artificial sunshine of special electric light. Their home will be transformed into a very successful imitation of a real tropical region and they will be able to imagine themselves back in their native land!

This conversion to electric heating is only part of a comprehensive scheme that is being introduced at the Zoo, and the reptile and monkey houses are also receiving special attention.



A ride on an elephant is, perhaps, the most popular entertainment of children who visit the Zoo. It is sad to learn that two of these uncomplaining "beasts of burden" have recently died

Two Elephants Die of Blood Poisoning

The Zoo authorities are rather worried just now because two elephants, "Indarani" and "Sundermallah," have died within a week of one another. "Indarani" died on Christmas Eve, apparently from pneumonia, and "Sundermallah" was found dead on the following Wednesday, apparently from the same cause. As is usual at the Zoo, post-mortem examinations were made and it was then discovered that both elephants had died of general septicæmia, or blood poisoning.

Dr. Vevers, Superintendent of the Zoo, states that the cause of this condition is a mystery. He adds that the authorities are inclined to suspect that the oil-cake upon which the animals had been fed recently might be the source of the trouble. This oil-cake is the only part of the elephants' diet that was imported from abroad and samples are being analysed.

These two elephants were probably the best known animals in the Zoo, as they were to be found practically every afternoon in the central walk of the gardens with a load of children on their backs. "Indarani" in particular was a great favourite with everybody, because of her gentleness and her love and care for children. She would nurse a baby with as much care as any human being, would rock it in a cradle, and would be quite prepared to kill anyone who approached with any harmful intent. Besides actually carrying people herself she had been used for some time in the work of training younger elephants for the task, and even in winter, when there were fewer visitors to the Zoo, she proved useful in moving heavy loads about the gardens.

* * * *

Fox as Keeper's Pet

A fox that is brushed and combed every morning and that loves nothing better than playing with children exists at the Zoo. His name is "Charlie" and he has reached the good old age—for a fox—of eleven years. When he was a year old the keeper of the wolves brought him to live in his own room, and he has remained tame and affectionate ever since.

Results of
Meccano Model-Building Contests

By Frank Hornby

Overseas "Machine Tool" Competition

THE Overseas Section of this competition yielded almost as many entries as the popular Crane Contest, about which I wrote last month, and the following description will show that the prize-winning entries are of greatly varied types.

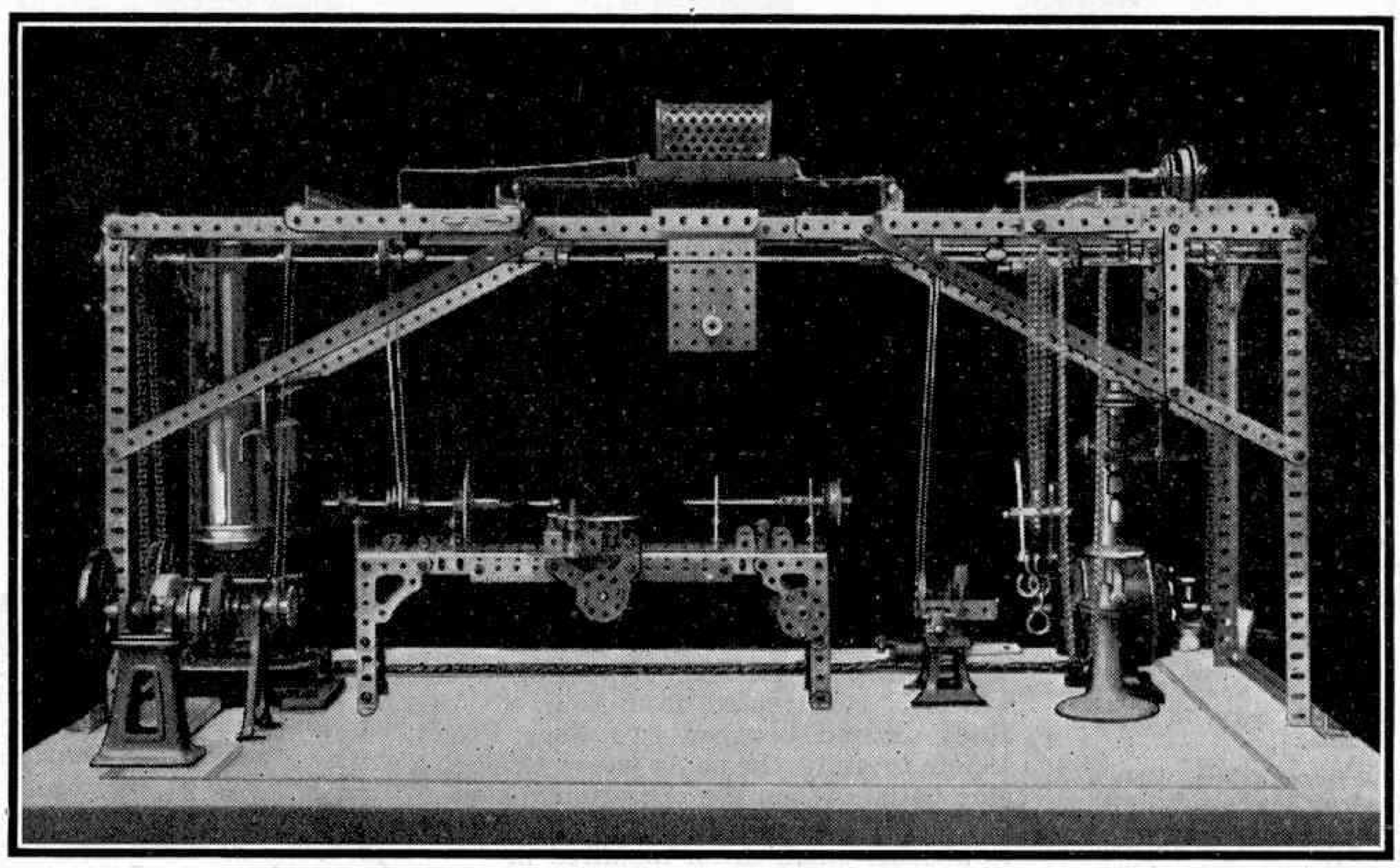
The names of the successful competitors are as follows :—

First Prize (cheque for £3-3s.) : Sta. Gimenez, Calle de Miguel Ferrer 4-2a-1a, Lerida, Spain. Second Prize (cheque for £2-2s.) : John Bull, 5, Rae Street, Auburn, Victoria, Australia. Third Prize (cheque for £1-1s.) : W. F. Spilhaus, "Lubeck," Lochiel Road, Rondebosch, Cape Town, S.A.

Prizes of 10/6 each : H. V. Reynolds, Georgetown, B.G. ; L. Potter, Sydney, N.S.W. ; Maxwell Gage, Auckland, N.Z. ; Roy Bloomfield, Meranburn, N.S.W. ; A. R. Lyell, Hawthorn, Victoria, Australia ; H. Fagg, Milton, Otago, N.Z.

The following competitors, who are amongst those gaining Certificates of Merit, have been selected as deserving special mention :—

B. H. Moloney, Newara Eliya, Ceylon ; H. C. van Doorn, Utrecht, Holland ; F. Mulligan, Auckland, N.Z. ; J. Knox, Ontario, Canada ; J. Wray, Remuera, Auckland, N.Z. ; S. D. Cozens, Alberni, B.C. ; B. Swift, Montreal.



This complete model Workshop, built by Senorita Gimenez, was exhibited at Lerida, Spain. (Awarded First Prize)

I am very pleased to find that the First Prize in this competition has been carried off by a young Spanish lady, Senorita Gimenez. Although very many girls are included in the ranks of Meccano enthusiasts all over the world, their entries in the model-building contests are not as numerous as I could wish. Their skill in constructional work has often been demonstrated, however, and I feel sure all my readers will agree that the splendid model workshop illustrated on this page represents another important step in support of their claim for a fair share of the model-building honours !

Details of First Prize-winning Model

It is interesting to note that this model was on exhibition for some time in a shop window in Lerida, Spain, where it attracted a great deal of attention and much favourable comment. I congratulate Senorita Gimenez on her well-earned success.

The chief merit of the model lies in the disposition of its components, which enables all the machines to be driven from one over-head shaft. As will be seen from the photograph, power is supplied either by a vertical steam engine or a small electric motor, both of which are coupled to the overhead shafting by means of Sprocket Chain gear. A transformer fitted at the top of the model regulates the supply of the current for the motor and for the two electric lights suspended in a central position in the workshop.

The lathe, chain hoist, grinding shaft, framework, overhead-gear, and smaller fittings included in the model are constructed entirely from Meccano parts, and general interest is added to the layout by the inclusion of a miniature mechanical saw and drilling machine. The whole apparatus is screwed down to a suitable wooden base.

The Second Prize-winning model, constructed by J. Bull, forms a practical wood-turning lathe. The simplicity of its design is noteworthy, and the machine should provide many hours of very profitable amusement.

The lathe is supported upon an upright framework consisting of four 24½" Angle Girders suitably braced and tied ; these are bolted at their upper ends to the two horizontal 12½" Angle Girders that form the bed-plate of the lathe. The tail-stock, which supports the work at the end farthest from the chuck, slides upon these latter Girders, its movement being controlled by a hand wheel and screw gearing (see S.M. Nos. 135 and 136). The mandrel is journalled in reinforced bearings and carries in addition to the chuck and a flywheel several pulleys of varying diameters, which take the belt drive from the motor.

A Meccano Ice-scoring Machine

A very original model of an Ice Scorer and Header secured Third Prize for F. Spilhaus. The purpose of this machine is to score ice blocks both lengthwise and crosswise as they enter the storage vault for stacking, so reducing both the time and labour necessary in delivering the ice when it is needed. In the Meccano model the ice block enters the machine at one end on a continuous band driven by an Electric Motor and is "scored" lengthwise by a Sprocket Wheel, representing a circular saw. The block then continues its travel and by means of the ingenious Meccano mechanism, passes through the various stages of "heading" and scoring crosswise, and is finally delivered at the other end of the machine.

An interesting model of a very compact wood-working Mill gained a prize for H. V. Reynolds. This model is fitted with (1) a band-saw, (2) a ripping-saw, (3) a tool for cutting box corners, and (4) a drill. If desired, a chisel can be fitted in place of the drill and, by operating a lever, this can be used as a mortising tool. It is intended that the machine should be driven by belt gear from the Motor, and a belt-shifting device is provided. This consists essentially of one loose and one fixed Flanged Wheel arranged so that the belt can easily be moved from one to the other (see S.M. No. 18a, Belt Clutch).

Maxwell Gage submitted a radio honeycomb-coil winder in which the criss-cross arrangement of the wiring is obtained by an Eccentric. The size of the coil depends on the radius of eccentricity.

Master Bull tells me that with this machine he is able to turn numerous small articles from wood, including egg cups, toy soldiers, chessmen, etc. He uses an electric sewing-machine motor for driving purposes, but I may mention that some good examples of wood-turning can be produced with the Meccano high-voltage Motor, and even the 4-volt Motor may be used successfully for quite small work.

Result of the (1926) New Zealand Model-Building Competition

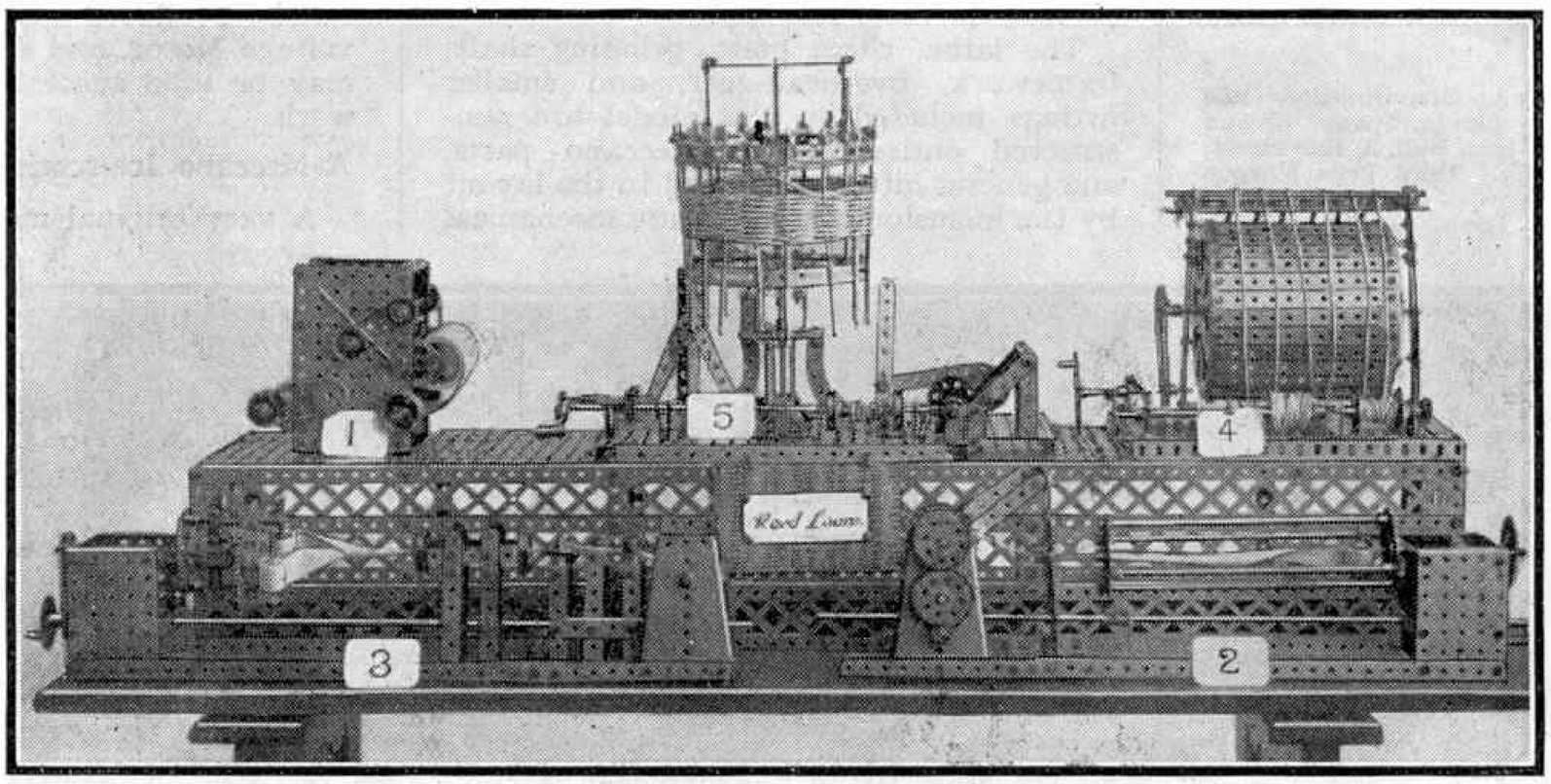
DURING the last few weeks we have been engaged upon the pleasant task of inspecting some of the entries received in the Model-Building Competition that was organised last year by our agents for New Zealand (Browning, Ifwersen Limited) for the benefit of Meccano boys who reside in that country. The quantity of the entries and the quality of the work exhibited serve to indicate the model-building skill possessed by the thousands of enthusiastic New Zealand boys who help to swell the ranks of the great Meccano family.

Entries in the Competition were divided into four sections according to the competitors' ages, and a very large number of prizes was distributed. The principal awards were as follows:

Section 1. First Prize: George P. Henwood, 56, Lake Road, Takapuna (Reed Loom Factory). Second Prize: John William Wray, 94, Lucerne Road, Remuera (Motor Lorry). Third Prize: Arthur Davies, 83, Balmoral Road, Mt. Eden (Dry-cleaning Machinery and Steam Press).

Section 2. First Prize: Colin Seccombe, Reparoa Rotorua (Tractor and Plough). Second Prize: Neil Macfarlane, 9, Gladstone Road, Napier (Steam Shovel). Third Prize: Marshall Saxby, 13, Clyde Road, Napier (Military Biplane).

Section 3. First Prize: Terrence Nelson, Matau, via Inglewood, Taranaki (Light Road Grader, with driver and horse). Second Prize: Stuart L. Taylor, 29, Russell Street, Palmerston, N. (Adding Machine). Third Prize: Halsey Rose Gunn, Wharf Street, Tauranga (American Breakdown Car).



Meccano Reed Loom Factory, built by G. P. Henwood (First Prize, Section 1)

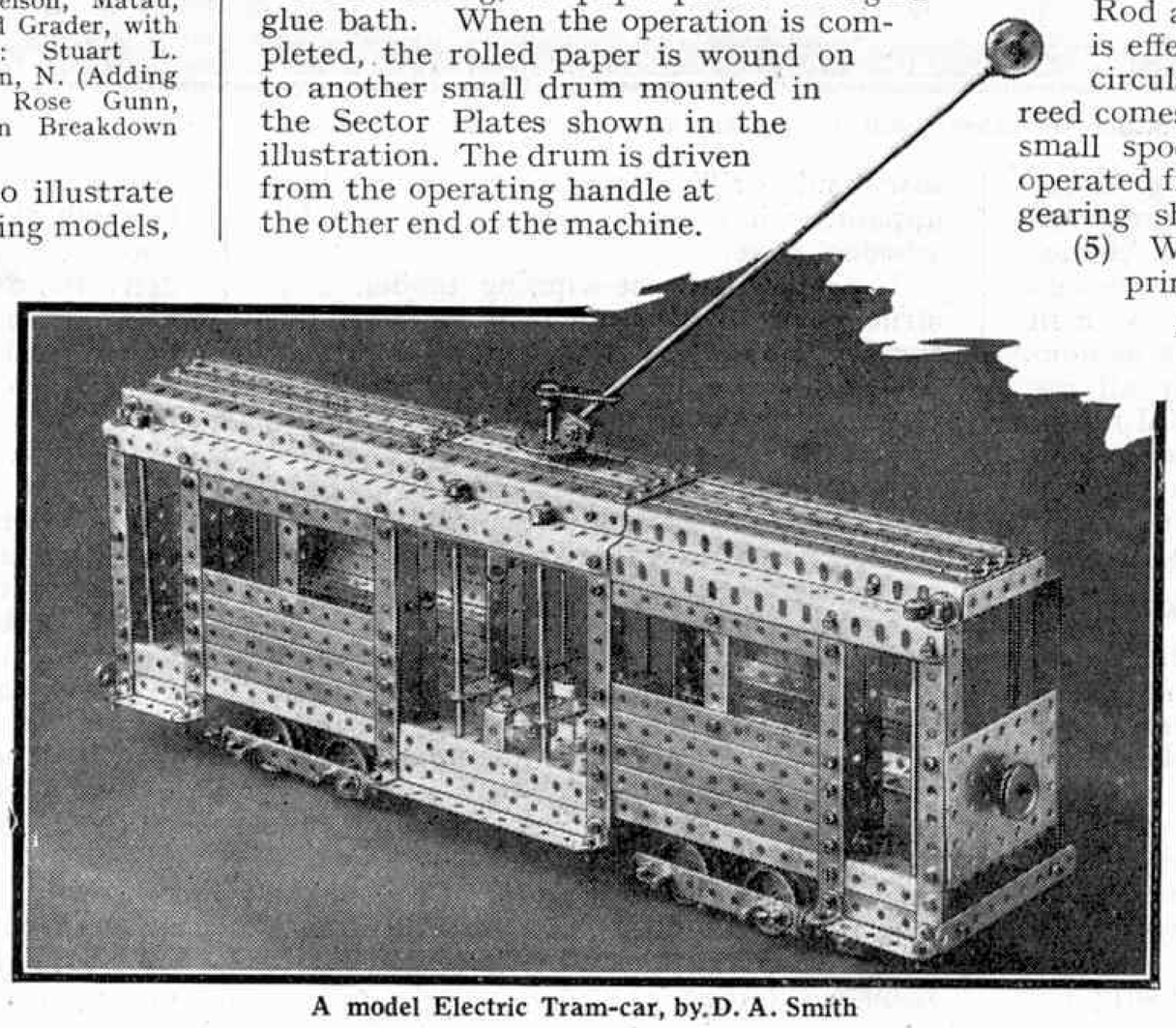
It is, of course, impossible to illustrate in the "*M.M.*" all the prize-winning models, although that is what we should like to do. We must follow last year's practice, therefore, and reproduce in this issue a few of the successful entries that specially appeal to us.

G. P. Henwood obtained First Prize in Section 1 for an original model of a Reed Loom Factory. This is shown in the larger illustration herewith and it will be seen that the apparatus possesses many interesting features. The various components of the "factory" are numbered in the photograph, and we append a brief description of each.

Description of Processes

(1) Cutting Machine. A roll of paper is mounted on the Meccano Wood Roller at the right of the machine, and from thence the paper is led via guide rods over another Wood Roller, which is fitted with cutters consisting of safety-razor blades. These cut the paper lengthwise, and the strips are then delivered to another roller at the opposite end of the machine.

(2) Twisting Machine. This apparatus twists the strips of paper tightly into tubular lengths. The roll of paper is mounted on a short axle carried transversely inside the large revolving drum, which is constructed from four 8″ Axle Rods secured between two Face Plates. Before twisting, the paper passes through a glue bath. When the operation is completed, the rolled paper is wound on to another small drum mounted in the Sector Plates shown in the illustration. The drum is driven from the operating handle at the other end of the machine.



A model Electric Tram-car, by D. A. Smith

(3) Wire Twisting Machine. In this machine the strips of paper are wrapped tightly round lengths of string or thin wire, instead of being twisted as in No. 2 machine. The main operating spool consists of a Face Plate connected to a 3″ Sprocket Wheel by two 2″ Rods secured in opposite holes in the surfaces of the wheels. Between the two wheels are two 1″ Pulley Wheels forming a drum on which the string is wound before being threaded through the boss of the Sprocket Wheel. The Face Plate and Sprocket Wheel revolve as one unit and twist the strips of paper, which are attached to the face of the Sprocket Wheel, round the string, while the latter is slowly drawn through two Flanged Wheels supported in the centre of the machine, over guide wheels, and so on to the winding drum.

(4) Drying Drum. The object of this apparatus is to dry the "reed" as it is delivered from the twisting machines. The drum is built up from two Hub Discs connected by a number of 5½″ Strips, and the reed is guided round it by means of Spring Clips spaced along an 8″ Rod at the top of the drum. Drying is effected in actual practice by steam circulated within the drum. As the reed comes off the drum it is wound on to small spools, the whole apparatus being operated from the hand wheel and sprocket gearing shown.

(5) Weaving Machine. This consists principally of two Circular Girders placed one above the other and rotated by suitable gearing. The lower Girder remains in the same horizontal plane while in motion, but the upper circular Girder gradually rises, the movement being effected by a 6″ Threaded Rod. Bolted to the circumference of the upper Circular Girder are nineteen Double Brackets, through which the lengths of wired reed are threaded. Each of the latter is fitted at the top with a Collar and set-screw, and the whole series is held in position by two lengths of Spring Cord led round just beneath the Double Brackets. The pliable reed from No. 2

machine is mounted on a spool in the base of the weaving machine and threaded through the vertical 4½″ Strip that can be seen in the illustration. This Strip is attached pivotally to the base of the model and may be worked to and fro by means of crank and connecting rod mechanism, and in consequence of this movement the reed is threaded in and out between the vertical wired lengths as the latter are carried round by the revolving Circular Girders.

Aeroplanes and other Models

The second illustration on the previous page shows an interesting model of an electric tram-car built by D. A. Smith. This vehicle is of the type that comprises two closed compartments and a central space in which open-air seating accommodation is provided. The tram-car is mounted on two four-wheeled bogies, each of which is pivotally attached to the underside of the frame.

Aircraft proved a very popular subject with the competitors and some excellent models of various types of aeroplanes were received. We illustrate two exceptionally fine Meccano models of this type. One of these secured Third Prize in Section 2 for Marshall Saxby, who was 13½ years of age when the model was constructed.

Saxby's aeroplane is complete in almost every detail. The pilot's cockpit is equipped with joystick, with which the elevators and ailerons may be controlled, and rudder bar connected by cords to the tail of the machine. The ailerons consist of Flat Girders attached to the main wings by means of Meccano Hinges. The under-carriage and tail-skid are fitted with shock absorbers formed from Meccano Springs, and the imitation engine fitted in the nose of the aeroplane consists of a series of Couplings and Meccano Springs, the latter being connected end to end to represent petrol and exhaust pipes. A miniature petrol tank is fitted to the upper wing and a quick-firing gun is mounted immediately in front of the forward cockpit.

The second aeroplane shown was built by Raymond Russell and represents a fast "scout" biplane. The general proportions of the model are excellent, and the complete machine gives a most realistic impression. The appearance of the model will be enhanced still further if the rear portion of the fuselage is filled in with further Meccano parts or strips of cardboard.

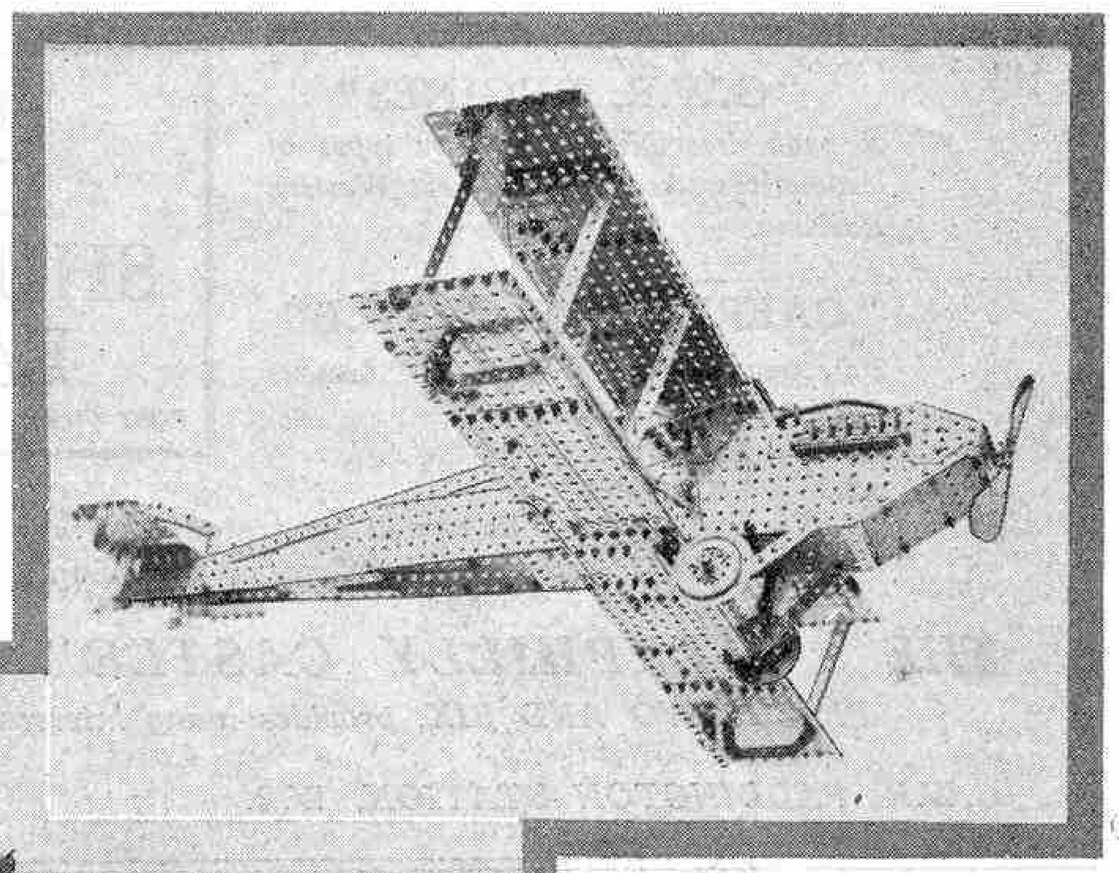
Another photograph accompanying this article illustrates a model Steam Shovel, which secured for Neil Macfarlane the Second Prize in Section 2. The model is driven from a Clockwork Motor, and every movement of the prototype is reproduced, the various motions including hoisting, racking, travelling, and swivelling of the jib. The bucket is fitted with a collapsible floor, which may be opened by pulling a cord. Observant readers will notice that the model is equipped with two outriggers, placed one on each side of the forward bogie. These consist of 2″ Sprocket Wheels secured to the lower ends of vertical Threaded Rods passed through the centre threaded holes of Couplings. On rotation of the Threaded Rods the Sprocket Wheels may be lowered into contact with the ground, thus bracing up the machine and relieving the strain that otherwise would be imposed upon the axle bearings and chassis springs when the machine is at work.

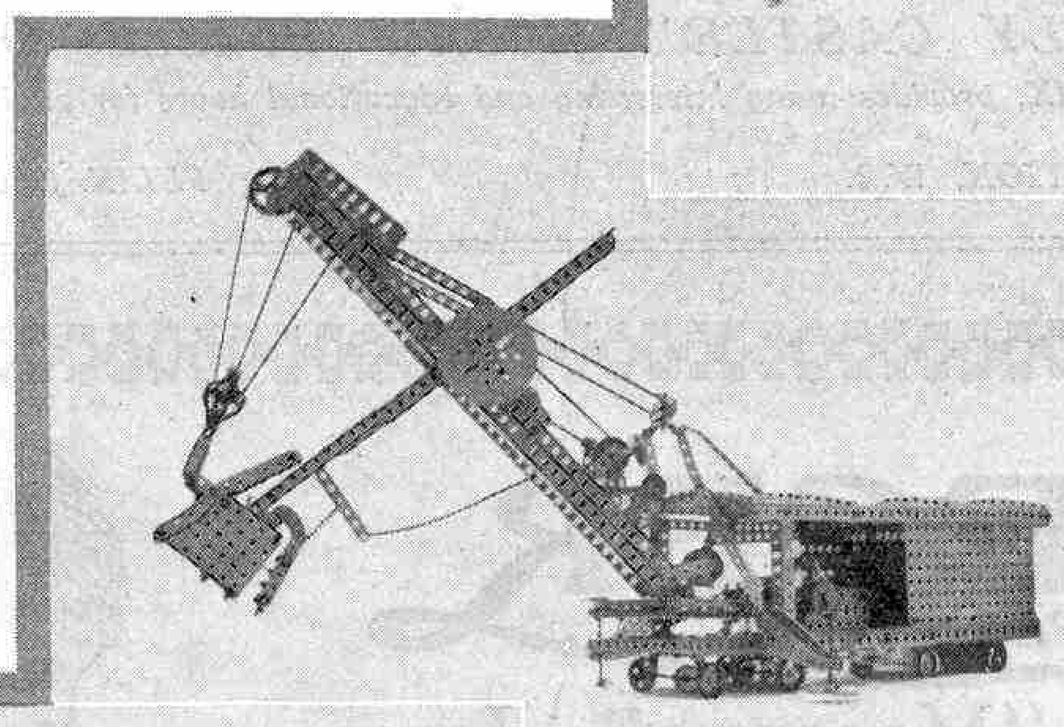
J. W. Wray's motor lorry was labelled "1936 design," and as may be gathered from this description the model embodies some striking innovations. It is fitted with imitation hydraulic tipping gear, gearbox comprising five forward speeds and two reverse, clutch, differential, four-wheel brakes and auxiliary magnetic brake, laminated springs, and buffers. The magnetic brake consists of a length of insulated wire wound round a core composed of several Axle Rods. The magnet so formed is operated from the accumulator and controlled by a foot switch situated near the driver. When the circuit is completed the magnet attracts a lever, which, in turn, applies a band brake operating upon 2″ Pulley Wheels secured to the rear axle.

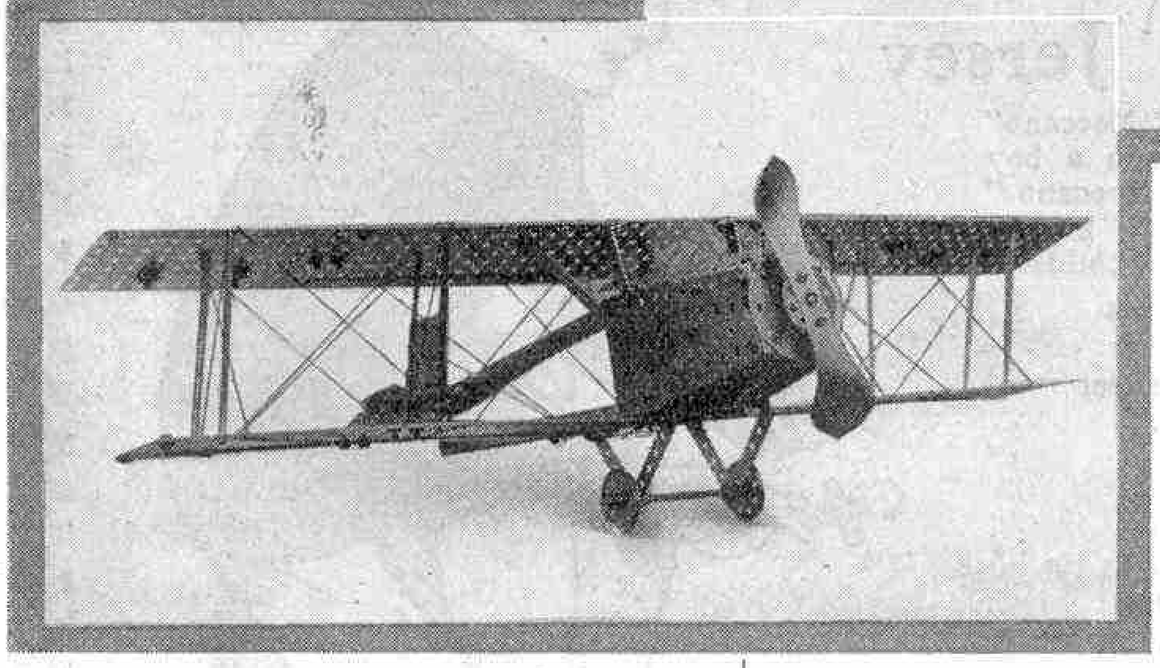
Dry-Cleaning Machinery

Arthur Davies submitted a very original model representing dry-cleaning machinery and a steam press. The model is arranged to represent a miniature work-room and the various component machines are all operated from a 4-volt Electric Motor. The steam press and dry-cleaning apparatus are particularly interesting.

The model with which Colin Seccombe secured First Prize in Section 2 is in the form of a Motor Tractor and Plough. The engine of the tractor is represented by a number of Meccano Couplings, and Hub Discs form the rear driving wheels. Realistic knives for the plough are provided by means of Propeller Blades. A Clockwork Motor built into the chassis framework drives the rear axle of the tractor.







Above: Military Biplane, constructed by Marshall Saxby

Centre: Steam Shovel, by Neil Macfarlane

Below: Scout Biplane, by Raymond W. Russell

New Contest for 1927

In conclusion we should like to draw the attention of all readers who reside in New Zealand to the splendid competition that has been organised by Browning, Ifwersen Ltd., for 1927. This competition is planned on similar lines to that of last year, and entries will be divided into several sections according to the ages of the competitors. Many handsome prizes, consisting of Meccano or Hornby Train goods to be chosen by the winners, are offered for entries showing particular merit. The contest is limited to New Zealand Meccano boys, and all entries must be received not later than 4.30 p.m. June 30th next. Would-be competitors may obtain their entry forms and all necessary particulars from their Meccano dealers or direct from Browning, Ifwersen Ltd., P.O. Box 129, Auckland, N.Z.

RAILWAY BOOKS for BOYS

All boys are interested in Railways. Four books published by the Great Western Company describe in a simple manner all that is most interesting about the railway that has been popularly named " The Holiday Line."

The locomotives of the G.W.R. are famous for their beauty of design, and their efficiency. " Caerphilly Castle " and " G.W.R. Engines " deals with every detail.

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JAEGER
Pure Wool

The New "Meccano" Jersey

This Jaeger "Meccano" Jersey is made in the special "Meccano" pattern. It wears splendidly and prevents chill when a boy gets hot, as every boy will sooner or later. The " Meccano " Jersey appeals to every boy at once as well as to the "grown-ups" who study the health, happiness and appearance of children.

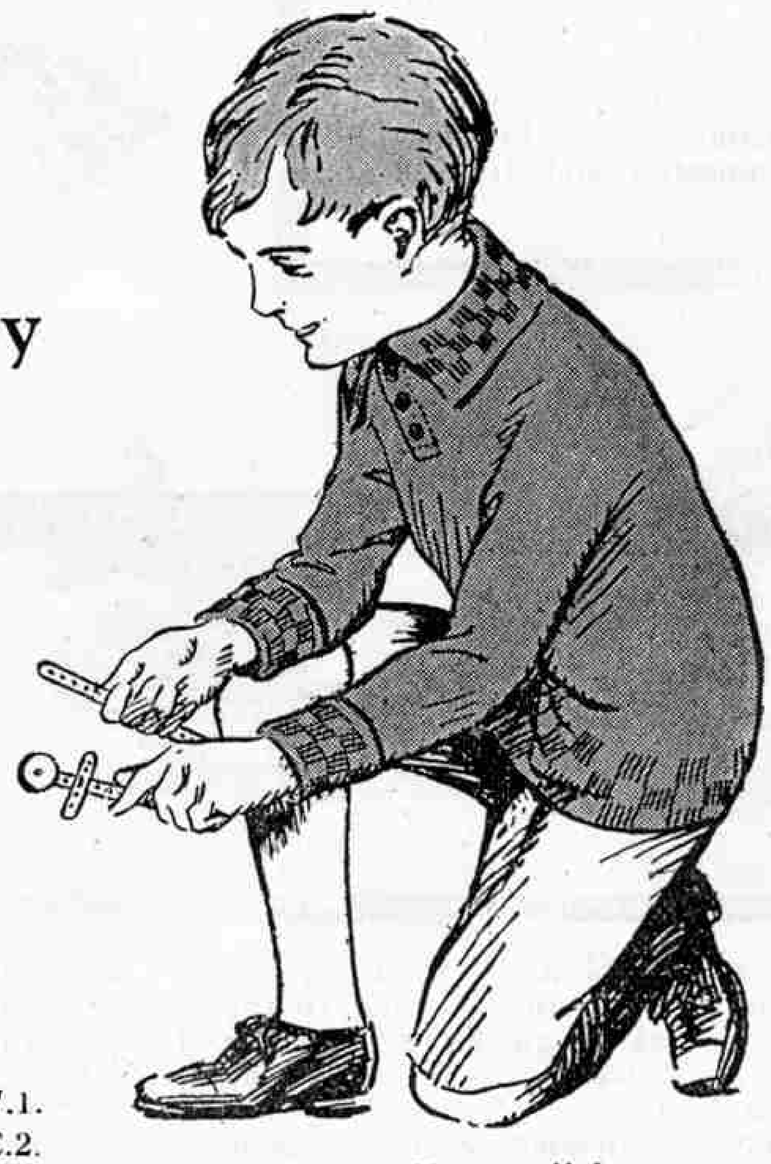
22″	24″	26″	28″	30″ Chest
7/–	7/9	8/6	9/3	10/–

Colours :—Navy body with Light and Dark Saxe dice effect
Mid Grey body with Black and White ,,
Fawn body with Brown and Saxe ,,
Brown body with Fawn and Red ,,
Saxe body with Navy and Dark Saxe ,,
French Grey body with Lt. and Dk. Saxe ,,

Three-quarter Hose, Turnover Tops to match

3, 4	5, 6, 7	8, 9, 10
2/9	3/3	3/9

Obtainable only from Jaeger Depots and Agents
(Write for the address of your Local Agent)



The New "Meccano" Jersey

JAEGER HEAD RETAIL DEPOT : 352/54, OXFORD ST., LONDON, W.1.
WHOLESALE & SHIPPING : 95 MILTON ST., LONDON, E.C.2.

BRANCHES : AUSTRALIA—Melbourne, 325, Flinders Lane. Sydney, 38/44, York Street.
CANADA—Montreal, 1187, Bleury Street.

The Meccano Guild

A Great Fellowship of Boys

President: Mr. Frank Hornby ——————Inventor of Meccano

What the Guild Means

The Meccano Guild is an organisation for boys, started at the request of boys, and conducted as far as possible by boys. In joining the Guild a Meccano boy becomes a member of a great brotherhood of world-wide extent, every member of which has promised to observe its three great objects ; wherever he happens to be—even in strange countries—he will know he has met a friend whenever he sees the little triangular badge. The Meccano Guild is bringing together Meccano boys all over the world, and is helping them to get the very best out of life.

How it Commenced

More than a million boys in Great Britain derive their greatest indoor pleasure from Meccano. Before the Guild was formed, hundreds of these Meccano boys wrote to us every week. They told us how they wished they could be put into communication with other Meccano boys and how they longed to be able to meet them. They asked if arrangements could be made so that their wishes might become an accomplished fact. We responded to their repeated and increasingly numerous appeals, and as a result the Meccano Guild came into being.

Why You Should Join

Every Meccano boy should be a member of the Meccano Guild. All who have studied its objects must agree that the Guild cannot fail to have a profound effect for good on the lives of its members. It is ready to be of service to each individual member—to help or give advice whenever requested. At the head—guiding and controlling, and taking a personal interest in this great movement—is the President, Mr. Frank Hornby, Inventor of Meccano and Managing Director of Meccano Limited.

The Headquarters of the Meccano Guild are at the Head Offices of Meccano Ltd., Binns Road, Liverpool.

THE GUILD RECRUITING CAMPAIGN

Every Meccano boy should become a member of the Guild and do his utmost to help to make the objects of the Guild widely known. With this end in view, a Special Medallion is presented to each member of the Guild who obtains three new recruits. As a mark of further merit the medallion is engraved with the name of the recipient and with the words " Special Award " when six more members are recruited, making nine in all. Full particulars of the Recruiting Campaign, together with a supply of application forms, will be sent on request.

HOW TO BECOME A MEMBER

Membership of the Guild is open to every boy possessing a Meccano Outfit, or Hornby Train Set, who satisfactorily fills in the prescribed application form. The only conditions are that members promise to observe the objects of the Guild and to wear their badges on all possible occasions.

The price of the Guild membership badge is 7d. post free in the United Kingdom, but members abroad will be required to pay 5d. extra for registered postage A remittance for the necessary amount should be sent along with the form of application. The Guild badge is beautifully enamelled in blue and white and is made for wearing in the lapel of the coat Any boy wearing the Guild Badge is at once recognised by other Meccano boys as being a member of the Guild and one who has undertaken to live a clean, truthful and upright life.

In addition to the badge, each member receives a membership certificate, measuring 7″ × 9½″ This certificate is printed in orange and sepia and is a smaller edition of the large club certificate.

Write to the Secretary of the Meccano Guild, Binns Road, Liverpool, asking for an application form and full particulars. Then fill in the form and return it to Headquarters. when you will be enrolled and your badge and certificate will be sent to you. Write to-day, and put M.N. after your name for reference.

The Secretary receives hundreds of letters every week from members all over the world and he hopes that new members will also write to him as often as possible.

MECCANO CLUBS

Meccano Clubs are founded and established by enthusiastic Meccano boys under the guidance of the Guild Secretary at Headquarters. At the present time there are over 100 affiliated clubs in various towns and villages in this country and abroad, together with a much larger number not yet affiliated. Each club has its Leader, Secretary, Treasurer and other Officials, all of whom, with the exception of the Leader, are boys. If the nearest club to you is too far away for you to join, or if you are unable to join for any other reason, consider the possibility of forming a new club in your own district. A special booklet explaining " How to run a Meccano Club " is now ready, and will be sent to any reader (post free) on receipt of 2d. in stamps.

AFFILIATION WITH THE GUILD

When a Meccano Club has been successfully launched and good progress is being made, affiliation with the Guild is granted. A beautiful club certificate, suitable for framing and hanging in the club-room, is presented, and the club becomes entitled to such privileges as the loan of interesting lectures and club membership cards.

All members of the Guild are eligible for the Merit Medallion, which is awarded to those who display special ability in connection with club work. or in helping the Guild.

THE CORRESPONDENCE CLUB

Members of the Guild are able to join the Correspondence Club, by which they are placed in communication with other Guild members in some other part of the country or abroad. To those boys who are interested in foreign languages the Correspondence Club presents a splendid opportunity of obtaining a correspondent in the particular country in the language of which they are interested. They are able to write to a Meccano boy in his native language, and as he would probably reply in English, the correspondence will be of mutual benefit. Stamp collectors also find the Club of value, as they are enabled to exchange stamps with their correspondents. Full particulars and enrolment form will be sent on application.

BADGE OF MEMBERSHIP

THE THREE GREAT OBJECTS OF THE GUILD

(1) **To make every boy's life brighter and happier.**

(2) **To foster clean-mindedness, truthfulness, ambition, and initiative in boys.**

(3) **To encourage boys in the pursuit of their studies and hobbies, and especially in the development of their knowledge of mechanical and engineering principles.**

BADGE OF MEMBERSHIP

With the Secretary

Life Story of Meccano in Tableaux

An interesting feature of a recent social evening and concert held by Malvern Wesleyan Meccano Club, Johannesburg, was a series of tableaux entitled "*The Life Story of Meccano.*" When the curtain rose, two boys dressed in pyjamas were seen playing with a Meccano Outfit by a large fire. In a chair near the fire their father sat reading, and after a while he asked the boys if they would like to hear the life story of Meccano. One boy climbed on to his knee and the other sat at his feet, while they enthusiastically asked for the story. He then commenced his recital, during the course of which tableaux representing the various stages of Meccano were enacted by other players.

The year 1901 was represented by a young boy with a tin and a few Meccano parts. As the story progressed, picturesque representatives of each era entered silently and remained on the platform. At last 1926 was reached, and two boys entered bearing a board on which was the Eiffel Tower Model. They were dressed in white shirts and blue "shorts," and one had "19" on his shirt and the other "26."

The Guild was represented by a boy with a placard on which was painted the Guild badge, and another boy who carried a placard on which was a map of South Africa with the names of all the South African Clubs received a great ovation. Still another member bore a large Club Certificate, and the various countries of the world were represented by members dressed in characteristic costumes.

The organisers of this playlet are to be congratulated on the ingenuity of the idea and the capable manner in which it was carried out.

Hints for Exhibitions

At this period of the year many Meccano Clubs are contemplating holding an Exhibition at the close of the session, with the two-fold object of giving a thoroughly good finish to the session and of raising funds for the purchase of various kinds of equipment for the coming outdoor season. I receive a considerable number of letters from Club Leaders or secretaries asking advice regarding such a scheme, and in particular enquiring which Meccano models can be used successfully to provide a sort of "side show" that will yield a small but useful revenue. I take this opportunity, therefore, of pointing out once more the possibilities in this direction of the Silhouettograph (Model No. 634) and the Meccanograph (Model No. 708).

Two Useful Models

The Silhouettograph comes as a novelty to most people and invariably proves a great attraction. With a little practice really good results may be obtained by it, and it is surprising how eager people are to be silhouetted when they have seen the likenesses obtained by their friends. If a small fee is charged for each person quite a considerable sum may be collected.

The writing arm is extended by means of 11½ in. Axle Rods and Couplings for a distance of approximately 3 ft. The person whose head is to be drawn is asked to sit with his profile exactly opposite the writing board, which should be a sheet of very stout cardboard, or preferably a smooth piece of wood. The outer end of the writing arm is then passed steadily round the profile while a piece of pencil lead secured in a coupling at the other end executes a likeness on a sheet of paper pinned to the writing board. The pencil is held against the paper by slight pressure exerted through a spring.

As regards the Meccanograph, little need be said. Its popularity is remarkable wherever it is exhibited and frequently it is a means of opening people's eyes to the wonderful possibilities of the Meccano System. It is generally quite easy to persuade people to pay a small fee to make a design of their own and it is a common thing for them to become so fascinated by the machine that they make quite a number of designs before they can tear themselves away!

Simple Competitions

In addition to these models, simple competitions may be made a source of small but useful profit. A very successful scheme is to fill a glass jar with Meccano Nuts and Bolts, previously counted, and invite people to guess the exact number in the jar. A small charge is made for each guess and a small prize is awarded to the one guessing the exact number or if, as is extremely likely, nobody guesses the exact number, to the one whose estimate comes nearest to it. Another useful competition on similar lines consists of inviting people to inspect a certain model and guess the total number of holes in the strips, etc. composing it, or the number of Nuts and Bolts used in its construction.

Letters from the Gold Coast

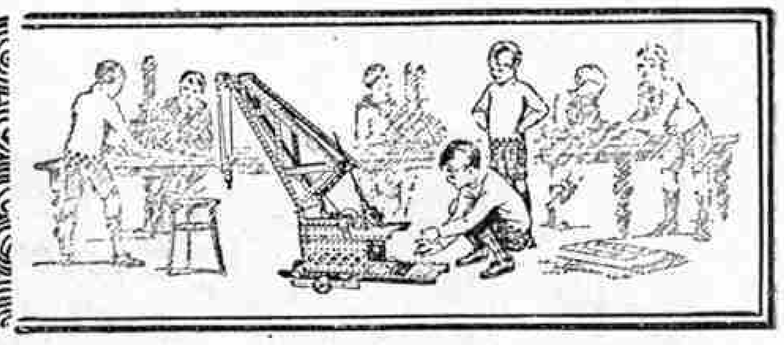
Once again I must warn members of the Guild, and indeed all Meccano boys, against entering into communication with boys from the Gold Coast. Unfortunately, a certain class of boys from this part of the world adopt very unscrupulous tactics. They obtain the names and addresses of English boys from the pages of the "*M.M.*" and write to them expressing a desire to open up correspondence, at the same time asking for gifts such as handkerchiefs, fountain pens, etc., to be sent to them. In return they promise to send monkey skins and other curios, but the trouble is that these return gifts never arrive! I therefore strongly urge all Meccano boys who receive letters from unknown people in the Gold Coast to destroy such letters immediately.

Proposed Clubs

Attempts are being made to form Meccano Clubs in the following places, and boys interested in becoming members should communicate with the promoters, whose names and addresses are given :—

SHEFFIELD—C. Banks, 19, Clementson Road, Crookes, Sheffield.
BRADFORD, EAST BOWLING—I. Davis, 8, Hirst Street, Off Wakefield Road, East Bowling, Bradford, Yorks.
CARLUKE (LANARKS.)—J. McGregor, Brownlee, Nr. Carluke, Lanarks., Scotland.
LEEDS, HAREHILLS—R. K. Fourness, 12, Berkeley Street, Harehills, Leeds.
FARNBOROUGH—K. S. Rawlins, 12, Church Circle, S. Farnborough, Hants.
SUTTON-IN-ASHFIELD—J. Winfield, 1, Hardwick Street, Sutton-in-Ashfield, Notts.
ABERFELDY—W. McDonald, 4, Kenmore Street, Aberfeldy.
BATH—R. W. Roseveare, Monkton Combe Jnr. School, Combe Down, Bath.
BEITH—C. Gillespie, 19, Townhead Street, Beith, Ayrshire.
NETHERFIELD—F. Kitchen, 172, Curzon Street, Netherfield, Nr. Nottingham.
INDIA, BOMBAY—T. D. Aria, Naguji Sayaji Building, 2nd Floor, Balaram Street, Bombay, India.

CLUB NOTES



St. George's (London) M.C.—An Exhibition was recently organised with great success, a special working model being loaned from Headquarters. The formation of a branch club is under consideration, and the Leader, Mr. Wilcox, is endeavouring to secure a second club room. Club roll: 58. *Secretary*: A. J. Wilcox, 103, Durban Road, West Ham, London, E.15.

Bearwood (Birmingham) M.C.—The Recruiting Month recently held proved very successful, and it is proposed to introduce a new scheme whereby a prize will be awarded to the most successful recruiter at each month end. Recent activities include a Meccano Prize Night, Games Competition Night, a "Talk on the Game of Chess" delivered by the President, the Rev. Mr. Hulbutt, and a "Do As You Like" Evening. Club roll: 40. *Secretary*: C. G. White, 72, Katherine Street, Bearwood, Birmingham.

Heswall M.C.—A Football Team has been organised. The winter syllabus includes chiefly Model-building, Socials, and Games Evenings. Club roll: 20. *Secretary*: A. G. Birch, Moor Cottage, Tower Road South, Heswall.

Exeter M.C.—An Exhibition of Models was held in connection with Exeter Carnival, and was very successful, over 400 people visiting it. Among the many fine models was one of a clock built by two members under eleven years of age, and this attracted much attention. Mr. L. G. Lendon has been promoted to the position of sub-Leader in recognition of years of steady service to the club. Club roll: 255. Sub-Leader: Mr. L. G. Lendon, "Homeside," 72, Old Tiverton Road, Exeter.

St. Michaels (Teignmouth) M.C.—The secretary has unfortunately had appendicitis and consequently has not been able to attend the meetings. It is very regrettable that he is obliged to resign the secretaryship owing to his health. A Football Ground has been secured and the members of the team hope to put in more practice than has before been possible. Leader: Rev. J. R. Hopwood, 2, Thornhill, Teignmouth, Devon.

Wyggeston Boys' M.C.—An Exhibition is being arranged and members are hard at work preparing a Display of Models. Two prizes have been offered by a patron of the club for the two best original models produced. Altogether six prizes are offered for exhibition work, three in the senior section and three in the junior. Club roll: 36. Leader: Mr. G. F. Reynolds, Wyggeston Boys' School, Leicester.

Pershore M.C.—Recent meetings have been devoted to rehearsals for a Christmas Concert and to Football practice. Electricity is being installed in the home of the secretary, where a large dance room is used for club meetings. Various members have their Guild certificates framed and hanging on the walls of this room along with the club's affiliation certificate. Club roll: 18. *Secretary*: Tom Pettifer, High Street, Pershore, Worcs.

Winchmore Hill Collegiate School M.C.—Recently held its first birthday and the occasion was very much enjoyed. Lecture evenings are popular and in particular a lecture on "Carpentering," delivered by the Leader, was well attended and enthusiastically received. Club roll: 41. *Secretary*: K. Walden, 18, Old Park Road, Palmers Green, London.

West Leeds High School M.C.—Is making good progress and the membership is well maintained. A recent Inventors' Night proved highly successful and many good models were submitted. It is hoped to introduce a club Magazine in the near future and this will be sold for one penny per copy. Club roll: 43. *Secretary*: B. Mather, "Lynbridge," Ridge Road, Armley, Leeds.

Combe St. Nicholas M.C.—Recent activities include the reading of a Lecture entitled "The Story of the Motor Car," which was loaned from Headquarters. Meetings are well attended and the members are very enthusiastic. Club roll: 18. *Secretary*: K. Hake, Combe Wood, Combe St. Nicholas, Nr. Chard, Somerset.

Middlesbrough M.C.—A Lecture, "The Story of Our Ships," loaned from Headquarters, was well received. A Contractors' Night recently held proved so successful that it is hoped to organise a similar evening in the near future. Mr. W. H. Spiers has been appointed President, and he recently delivered a Lecture to the club. It is proposed to print three copies of the club Magazine for circulation among the members. Club roll: 46. *Secretary*: A. Bradley, 23, Laurel Street, Middlesbrough.

Withington (Manchester) M.C.—Is making excellent progress and a recent Lantern Lecture given by the Leader, Mr. A. Cradduck, was greatly enjoyed. Plans for the future include Model-building and further Lectures. Club roll: 10. *Secretary*: Kenneth Cradduck, 36, Mauldeth Road West, Withington, Manchester.

Chalmers Church (Alloa) M.C.—Meetings are held for Model-building and Games, Bagatelle and Quoits being popular features. Two Meccano outfits have been presented to the club and these are greatly appreciated. A recent Lecture entitled "Across Canada by Canadian Pacific" was delivered by Mr. Robert Kinmond, J.P., F.E.I.S., and was greatly enjoyed. The prize-winning models in a recent competition are being exhibited in a local shop window. Club roll: 47. *Secretary*: George Campbell, Grange Manse, Alloa, Scotland.

Meccano Club Leaders

No. 31. Miss Constance Brookes

Miss Constance Brookes is Leader of the St. Albans Meccano Club which was founded in February 1926 and affiliated in the following June. For a time the club suffered under the severe handicap of being without a club room but fortunately suitable accommodation was secured in October last.

Miss Brookes has proved herself a very energetic and capable Leader and the club is now prosperous in every way. Cycling is a popular feature with the members and in the summer months country rambles are organised and are well attended.

Weston M.C.—Has held a very successful Exhibition at which a charge of 6d. was made for admission. Some very fine models were exhibited, including one lent by the Bristol Meccano Club. The models included a Stiff-leg Derrick, Horizontal Engine, Cross-Channel Biplane, Meccanograph and Platform Scales, and in addition a Model Workshop and Motor Chassis were loaned from Headquarters. An "Amusement Park" proved very popular and valuable assistance was given in this direction by Mrs. Nichols, mother of the secretary. A "Hat Trimming" Competition for men caused great amusement. On New Year's Eve a very jolly party was held and was greatly enjoyed by the members. It is hoped to secure a larger club room in the near future. Club roll: 21. *Secretary*: Ralph B. Nichols, 3a, Royal Parade, Weston-Super-Mare.

Italy

Siena (Italy) M.C.—This club is making good progress and meetings are well attended. New rules have been drawn up for the coming session. Several of the members recently have joined the Meccano Guild. Club roll: 7. *Secretary*: Valentino Bruchi, 39, Via Ricasoli, Siena, Italy.

India

Calcutta M.C.—Prize-giving Night was organised recently, and the annual report, which has since been published in booklet form, was read aloud by the Leader. Recent lectures have been delivered on various subjects, including: "Village Construction," "Oil Power in Modern Industries," and "School Boys in England." Other activities include "At Homes," Radio Evenings, Picnics, Football Competitions, Essay Competitions, and Model-building Contests, for which prizes were awarded. Sir R. N. Mookerjee, the club's President, was recently appointed a member of the Royal Currency Commission. Club roll: 100. *Secretary*: A. N. Roy Chowdhry, 9, Hungerford Street, Calcutta, India.

Argentine

La Plata (Argentine) M.C.—Good progress is reported. A seal is being prepared bearing the inscription "*La Plata Meccano Club*," and in the centre will appear the Guild badge. The club library is very popular and several new books have been added. It is hoped to form a Cycling Club in the future and a Radio Set is to be procured. Club roll: 23. *Secretary*: Luis H. V. Tangster, 46, No. 548, La Plata, Argentine, S. America.

Clubs not yet Affiliated

Barrow M.C.—Some time ago a very promising club was established at Barrow but this had to be disbanded. Efforts at re-organisation are now being made, and the support of Meccano boys in the district will be welcomed. Full particulars may be obtained from Stanley Green, 31, Mount Pleasant, Barrow-in-Furness.

Insein (Lower Burma) M.C.—An attempt is being made to establish a club at Insein, Lower Burma. An adult Leader has been obtained and the club already has six members. Boys in the neighbourhood who are interested should communicate with Maung Mya Maung, 2, East Road, Insein, Lower Burma, India.

Mussoorie (India) M.C.—It is proposed to form a club at Mussoorie, India. The services of an adult Leader have already been promised. New members will be very welcome and full particulars may be obtained from R. Fitzpatrick, Doon View, Landour, Mussoorie, U.P. District, India.

Westmount (Canada) M.C.—Plans are going forward for the establishment of a club and the support of local boys and girls is invited. To obtain further particulars, either write to, call upon, or 'phone (Westmount 5290) the *Secretary*: Ernest A. Rawlings, 2, Albert Place, Westmount, Quebec, Canada.

South Liverpool M.C.—Mossley Hill boys will be pleased to hear of a movement on foot to establish a club in South Liverpool. Full particulars may be obtained from Arthur Hague, 16, Rutherford Road, Mossley Hill, Liverpool.

Brondesbury Park (London) M.C.—It is proposed to form a club in the Brondesbury Park District, London, and the secretary would like to hear from any boys over ten years of age who are interested in the scheme. *Secretary*: W. Max Staples, "Northolt," 121, Hanover Park, London, N.W.10.

Dunedin (New Zealand) M.C.—It is hoped to establish a club very soon and there is an adult Leader in view. Particulars may be obtained from Robert Bruce, of 144, Stuart Street, Dunedin, New Zealand.

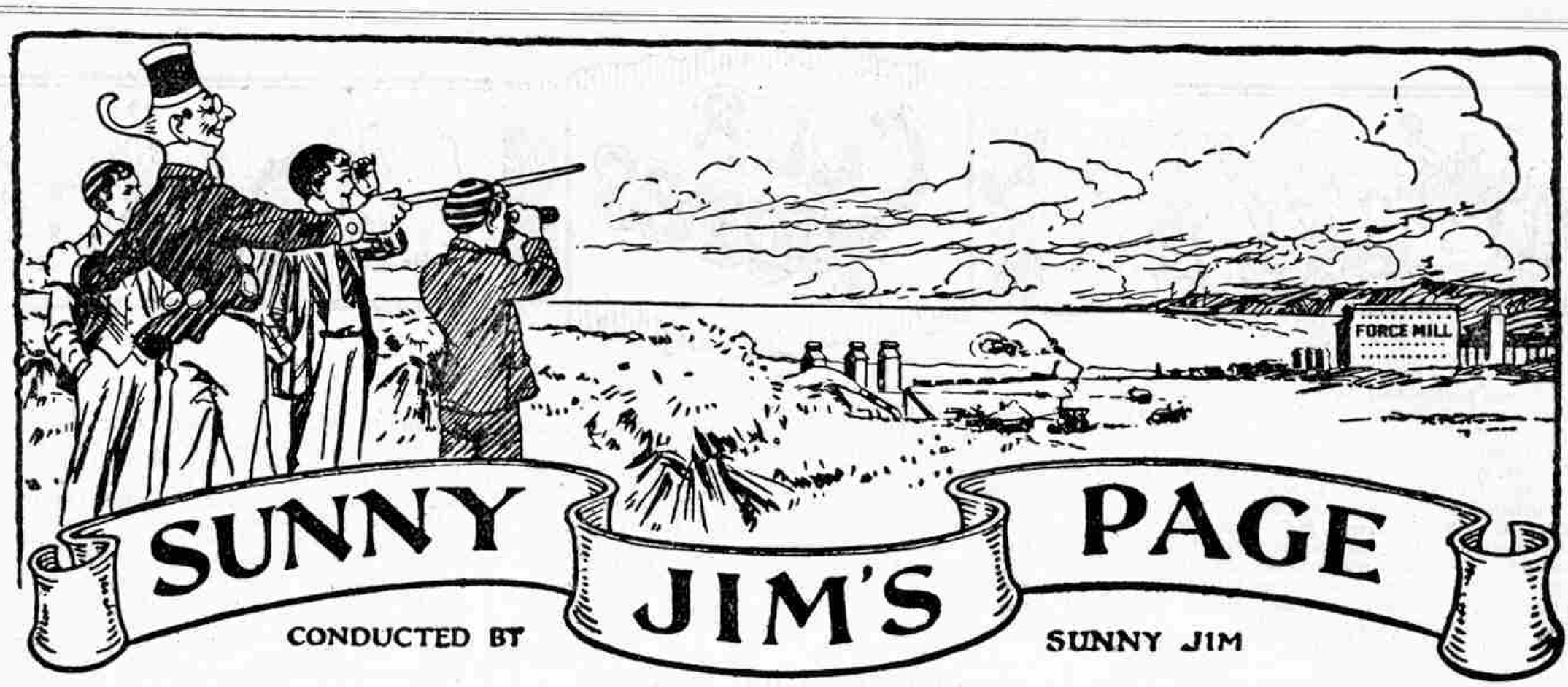
Bexley M.C.—Boys living in the vicinity of Bexley, Bexleyheath, and Crayford will be interested to learn of the proposed formation of a club at Bexley. Particulars may be obtained from Jack Dippy, "Colebrook," Knoll Road, Bexley, Kent.

Plymouth M.C.—A club is being formed and all Meccano boys interested are invited to give their support and to get in touch as soon as possible with Ronald Constance, 57, Rosebery Avenue, Plymouth.

Torquay M.C.—A club has been formed and several initiatory meetings have already been held. Particulars may be obtained from C. T. Callow, 23, Victoria Road, Ellacombe, Torquay.

Malta M.C.—Efforts are being made to re-organise Malta Meccano Club, which was disbanded some months ago. The support of boys in the locality will be welcomed by E. Bonnici, 25, Prince of Wales Road, Sliema, Malta.

Ceylon M.C.—The formation of a club at Colombo, Ceylon, is under consideration by a group of Meccano enthusiasts. Local boys interested may obtain full particulars from Torismund de Souza, Daisy Villa Avenue Bambalapitiya Colombo, Ceylon.



197, GREAT PORTLAND STREET, LONDON, W. 1.

WITH "SUNNY JIM" AT THE SCHOOLBOYS' EXHIBITION

At last the long awaited day had arrived, and Jim, Dick, and Tom, in London on their Christmas vacation, met together to visit the Schoolboys' Exhibition at the Horticultural Hall.

All were specially early that morning, they clamoured through breakfast and were soon hurrying on their way to this Mecca for boys of all descriptions. They emerged from London's Underground at Victoria Station and Jim asked a policeman the way.

"Follow the crowd," said the policeman. And sure enough there was an unmistakable crowd of boys streaming towards Victoria Street. Jim, Dick, and Tom fell in behind four or five Boy Scouts, each smartly turned out with accoutrements rattling as they walked. Spirits were high and the babel of voices grew clamourous as they neared the scene which drew this jolly throng. Boys were pouring in from all directions.

What a clatter and a hustle at the entrance. "Official Programme and Guide," shouted the attendants at the door.

"I'll have one," said Tom, and forked out 6d. on the spot.

They paid their entrance money and were soon in the thick of it all.

What a wonderful place it was. There seemed to be too much to see at once, and none of our party could agree as to which was the best way to tour the Exhibition, to make sure that nothing of interest was left out.

Jim solved the difficulty. He was looking over Tom's catalogue and noticed that "Sunny Jim" was there at the "Force" Exhibit.

"I know, fellows," he exclaimed, "Let's ask Sunny Jim to show us round; we are sure to find him somewhere about."

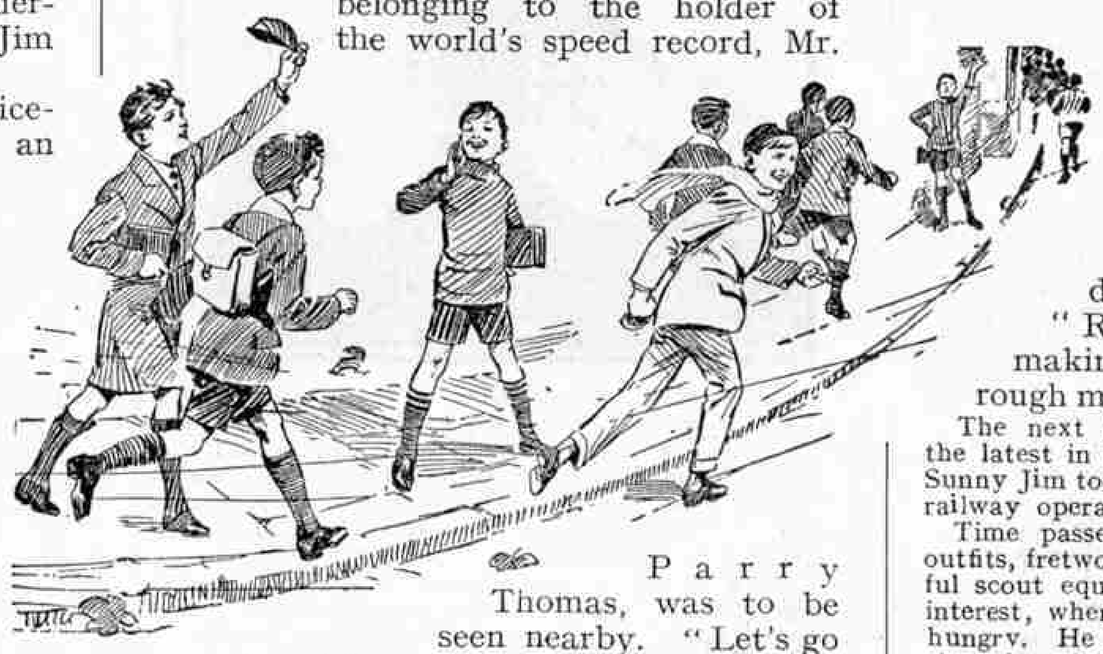
They kept their eyes open for the "Force" Stand, which was soon discovered by Dick.

"Here's 'Force,'" he shouted, "and there's Sunny Jim," put in Jim.

"Hello! Sunny Jim. How are you? We are three of your admirers on holiday in London, and we thought it would be nice to have you come with us round the Exhibition, if you don't mind."

"Of course I don't mind," said Sunny Jim, beaming with enthusiasm. "I shall be delighted. Where shall we go first?"

Tom looked at the catalogue and found that the racing motor car "Babs," belonging to the holder of the world's speed record, Mr. Parry Thomas, was to be seen nearby. "Let's go there!"



"Right-o," said Sunny Jim. "Follow me."

Sunny Jim was soon clearing a way through the crowd, and our three lucky Meccanoites followed him excitedly.

"Babs" was found drawn up alongside the big Leyland Thomas, but the Leyland Thomas looked small in comparison with this new monster.

"Here's 'Babs,'" said Sunny Jim, patting it affectionately.

"Mr. Thomas in 'Babs' has won the world's speed record for one mile flying start, at a rate of 171.09 miles per hour."

"Gosh!" said Dick, "but what about Captain Campbell?"

He is engaged in trying to break that record, and maybe before my words are in print he will have actually accomplished it in the "Blue Bird" on the Pendine Sands," replied Sunny Jim.

Above their heads was suspended a Hawker Cygnet, the winner of the first and second prizes in the "*Daily Mail*" Light 'plane Competition at Lympne 1926.

"Let's go up in the cockpit," exclaimed Tom. But the others were already climbing up the ladder to see how this wonderful machine was controlled.

Music suddenly seemed to come from no where in particular, and as the boys were looking round to find its source, Sunny Jim pointed out the Schoolboys' Orchestra in which was a 'cello player with an instrument as big as himself.

Half-an-hour was then spent examining the wonderful work done by the apprentices of the "Royal Air Force" who are busy making real aeroplanes, working up the rough material from blue prints supplied.

The next hour found them all occupied with the latest in model ships and model railways, when Sunny Jim took them to see a marvellously controlled railway operated entirely by wireless.

Time passed quickly amid a whirl of camping outfits, fretwork machines, stamp collections, wonderful scout equipment and a host of other things of interest, when Dick discovered that he was feeling hungry. He had but to mention the fact to make the others feel so too.

"Refreshments!" "You want Holforce," said Sunny Jim. So our friends went across to the "Force" Stand which they found surrounded by Boy Scouts, schoolboys, and others busily eating.

They paid 6d. each to the lady at the Stand who gave each one a packet of Holforce, which was quickly opened and the contents investigated.

Dick's eyes bulged with pleasure as he munched the palate-tickling food.

"Half a packet is a meal," said Sunny Jim, because Holforce is pure and is made with "Force," eggs, butter, sugar, milk and flour. Holforce is squares of concentrated nourishment, able to sustain a man and keep him fit and active the whole day long.

"Could I get Holforce at home?" said Tom.

"Of course you can," was Sunny Jim's rejoinder. "You must ask Mother to obtain it from her grocer's and send it to you regularly when you are at school. She will do it with pleasure when she knows how good it is—you need not tell her that the real reason you want it is because Holforce is such good 'tuck.'"

After the Holforce, Sunny Jim gave them all a plate of "Force" and fruit, which they eat with avidity.

Time was up; all three boys in a chorus of praise both for Sunny Jim and his wonderful products, shook hands again, gladly promising regularly to eat "Force" and Holforce too. A carrierbag each was given them in which to put the various things they had collected at the Exhibition, and they set off for home having spent one of the most enjoyable days of their lives.

February Puzzles

Puzzle No. 208. *Contributed by P. W. North (Clapham).*
The following arrangement of letters represents an ordinary long division sum that is to be converted into figures. The actual identities of the respective figures will be discovered by careful observation and, by applying the ordinary rules of arithmetic, it should be possible to solve the whole puzzle within ten minutes.

```
UGI)GEVPPNDO(IDTPO
   GVNI
   ----
  .DNTP
    UGI
   ----
  .NETN
   NEOT
   ----
  ..DUDO
    DUDO
   ----
   ....
   ----
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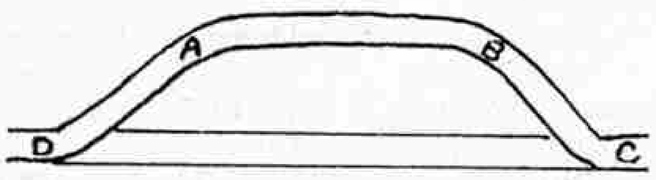
* * * *

Puzzle No. 209. *Contributed by S. Williams (Leeds).*
In the diagram below two trucks are represented by the letters A and B, while a locomotive stands at C. It is desired to place truck A in the position occupied by B and vice-versa. What is the least number of movements in which the transfer can be effected? A move is considered to be made when the locomotive changes direction.



* * * *

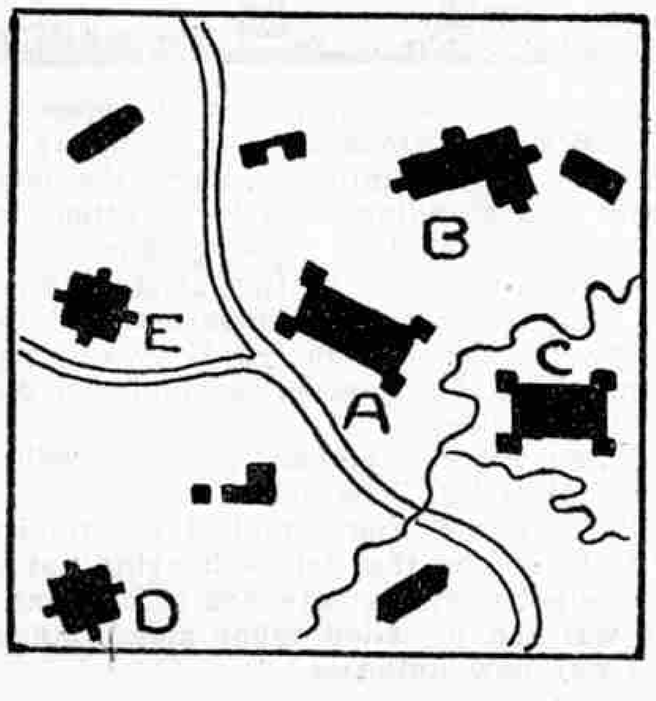
Puzzle No. 210. *Contributed by W. Lee (Belfast).*
Suppose the world to be a perfect sphere, with a steel band fitted closely round it so as exactly to encircle the whole earth. Suppose now that the band is taken off and one yard (36″) added to its length. What distance will the band stand off all round the world if it is fitted over it again?

* * * *

Puzzle No. 211.
Contributed by A. G. Colegrave (Banbury).
Divide a square into 7 parts so that the parts when correctly fixed together make 3 smaller squares of equal size.

* * * *

Puzzle No. 212. *Contributed by E. Watt (Lewisham).*
In the diagram below, figures A B C D and E are 5 buildings belonging to a large farm. The owner wishes to connect each building by telephone but the lines must be laid so that no two wires cross. How is it done?



Puzzle No. 213.
Three volumes of a certain book stood side by side in the following order from left to right on a book shelf, one, two and three. The thickness of each of the covers was $\frac{1}{8}$″ and the thickness of the total number of pages in each volume, 3″. On examining the volumes one day their owner found that a book-worm had bored a hole from the first page of volume one to the last page of volume three. How far had the book-worm travelled?

* * * *

Puzzle No. 214.
Two farmers each took 30 apples to market. A sold at two for a 1d. and B at three for a 1d. On their next visit to the market they worked together and sold their 60 apples at 5 for 2d. thinking that their profit would be the same. Was it? and Why?

* * * *

Puzzle No. 215. *Contributed by J. McNeil (Motherwell).*
Twenty-seven with three nines,
You and I can score,
Anyone on other lines
Can extend them more;
Who can write them to be seen
Equal only to sixteen?

* * * *

Puzzle No. 216.
Contributed by S. Waller (Stockton-on-Tees).
In the word square below the names of a number of well-known locomotives are hidden. Starting at a certain square it is possible to trace the names by moving one square at a time to adjacent squares. What are the names?

L	O	R	O	M	E	P	E
D	R	F	R	E	V	D	N
N	S	O	N	R	I	E	N
E	L	E	B	C	S	I	N
V	I	D	R	A	S	T	L
E	N	T	I	S	R	U	E
R	I	A	G	R	T	H	K
E	T	L	E	A	G	N	I

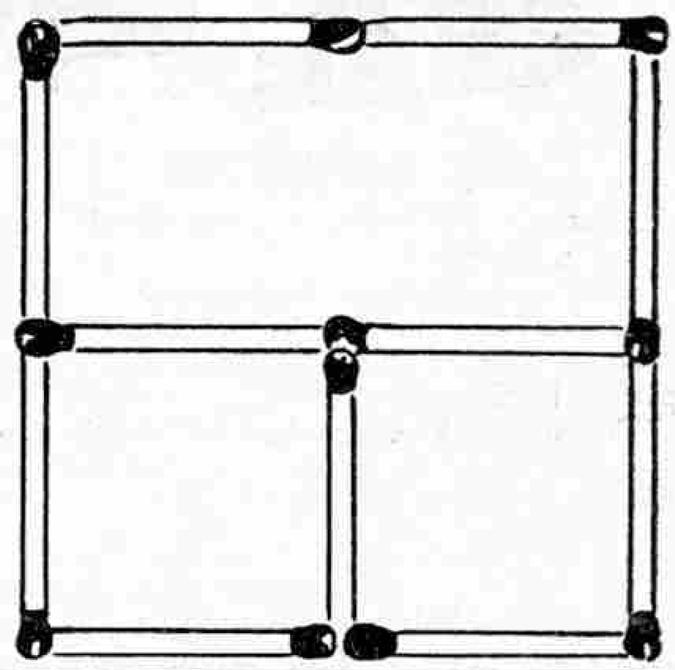
* * * *

Puzzle No. 217. *Contributed by R. D. Swift (Kildare).*
My first is in marrow, but not in bone.
My second's in plaster and also in stone
My third is in bullock, but not in steer,
My fourth is in buck, but not in deer.
My fifth is in car and also in cab
My sixth is in snatch, and also in bands
My whole brings joy to boys in all lands.

* * * *

Puzzle No. 218.
Contributed by I. S. Chisholm (Edinburgh).
My first is in cabin, but not in bunk.
My second's in portion but not in chunk.
My third is in heart, but not in soul,
My fourth is in ant, but not in mole,
My fifth is in hair but not in head.
My sixth is in silver, but not in lead.
My seventh is in horse, but not in ass.
My eighth is in number, but not in mass,
My ninth is in wind but not in gale,
My tenth is in travel, but not in sail.
My eleventh is in mountain, but not in pass.
My twelfth is in laddie, but not in lass.
My thirteenth is in wrong, but not in sin,
My last is in ash, but not in bin.
My whole is a well-known train.

Puzzle No. 219.
Contributed by R. W. Norman (Chesham).
Using 11 matches make the diagram shown below. How can 4 more squares be made by adding three matches?



Answers to Last Month's Puzzles

No. 197. The first traveller takes 7 pennies and the other 1.

* * * *

No. 198. Union Jack.

* * * *

No. 199. The plot of land was 16 square miles in area. Being square each of its sides must be four miles in length. The original puzzle states that the frontage to the main road was many thousands of feet in length and it was, therefore, obvious that the final answer must read in miles.

* * * *

No. 200. In elementary mechanics we learn that if a beam carrying a uniformly distributed load is supported at its two ends, each support takes half the load. Applying this to our problem, one end of the tube was rested on the spring balance and the other was packed up level with the balance. The weight registered was doubled and thus the weight of the tube was obtained.

* * * *

No. 201. ME–XI–CO.

* * * *

No. 202. A wig.

* * * *

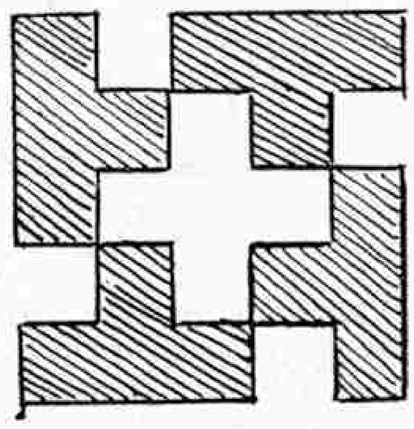
No. 203. Fred had 120 marbles.

* * * *

No. 204. A match.

* * * *

No. 205. The square is cut and re-arranged as shown below. The symmetrical Greek cross will be found in the centre.

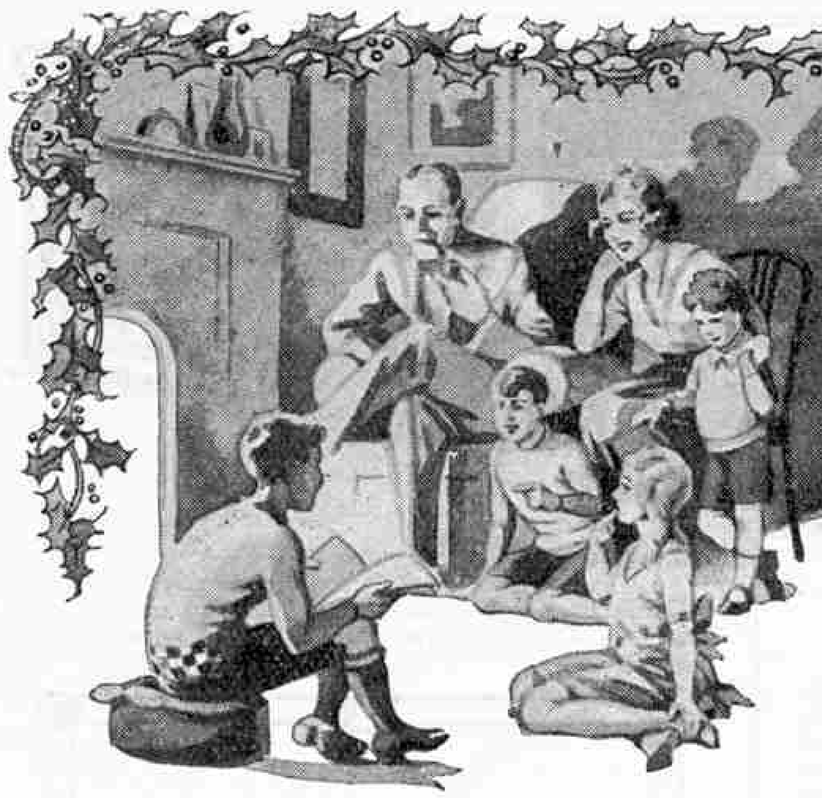


* * * *

No. 206. The word "Cares;" adding "S" makes the word Caress.

* * * *

No. 207. He bought 25 geese at 5/– each, and meant to ask 6/3 each.



Fireside Fun

BE GENEROUS

Tramp: "Please, ma'am, could you spare a copper?"

Woman (offering twopence): "Here you are; but don't think I give you this because you need it; I do it simply becauses it pleases me!"

Tramp: "Well, ma'am, if that's how you feel about it, make it a 'tanner,' an' have the time of yer life!"

* * * *

An old sea captain was reproving his daughter for being out late in an automobile with that "lubber," as he called her beau.

"But, father, we were becalmed," she exclaimed. "You see the wind died down in one of the tyres, and we had to wait until it sprang up again."

* * * *

During the War one of the great steamships that was used as a transport for soldiers was on her way across when a submarine was sighted. In anticipation of the danger they were in, all on board were lined on deck.

There was a deathly hush for an instant; then suddenly from down the line a negro's voice rang out: "Is dar ennybody heah dat wants to buy a gold watch and chain?"

* * * *

POOR FATHER!

Little Henpeck (buying new overcoat): "I can't wear this coat, Maria; it's much too big."

Hefty Wife: "I can't help that! Remember it's got to go over the radiator of the car in cold weather, and that's what we've got to consider first."

* * * *

Gibbleton: "Edison declares that four hours' sleep is enough for any man."

Briggs: "By! that is exactly what my baby thinks."

FROM THE LIMERICKS COMPETITION

An unpopular youth of Cologne,
With a pain in his stomach did mogne,
He heaved a great sigh
And said, "I would die,
But the loss would be only my ogne."

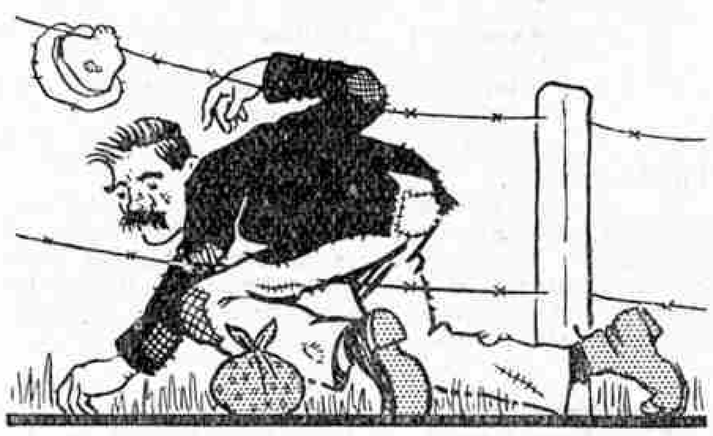
* * * *

Ancient Maiden: "Does this parrot swear much?"

Bird Dealer: "No, ma'am; but what swearing he does is very loud and clear."

* * * *

A TICKLISH PROPOSITION



Disgusted Tramp (in difficulties): "Why can't some fellow invent a blinking wireless fence."

* * * *

The caller, who was neither youthful nor of prepossessing appearance, anxious to gain the confidence of the son of the house, remarked pleasantly, "Why, Bobby, how grown up you are! But still, you are not too old to kiss, are you?"

"No," said Bobby, with conviction, "but you are!"

* * * *

COALS TO NEWCASTLE

An old gentleman saw a rural-looking man sitting on a stone wall swinging his legs and gazing at the telegraph wires. Approaching the man, he said: "Waiting to see a message go along, eh?" The man grinned and said "Aye."

The old gentleman got on the wall and for the next quarter of an hour tried hard to dispel the yokel's ignorance. "Now," he said at last, "as you now know something about the matter, I hope you will spread your knowledge among your fellow workers on the farm."

"But I don't work on a farm."

"Where then, may I ask?"

"Me and my mates are telegraph linesmen, and we are testing a new wire!"

* * * *

Employer: "What can you do, boy?"

Boy: "Anything, sir."

Employer: "Can you wheel a barrow full of smoke?"

Boy: "Certainly, sir, if you fill it."

PUTTING ON THE BRAKES

A negro minister was preaching a rousing sermon for the purpose of getting a big collection. In his remarks he cried, "Bruddern, dis church am got to walk!"

"Let 'er walk, brudder; let 'er walk," came in unctious tones from the 'amen' corner.

Warmed by this encouragement the preacher yelled, "Dis church am got to run!"

"Let 'er run, let 'er run," was the enthusiastic assent from the front seat.

"Dis church am got to fly, brudders, dis church am got to fly!"

This eloquence brought from the seat of honour the ecstatic response, "Let 'er fly!"

"And," continued the preacher, "it am gwine ter take money to make dis church fly."

Then from the amen corner came the low, mournful words, "Jest let 'er walk, brudder; jest let 'er walk!"

* * * *

The insurance agent was questioning the cowboy.

"Ever had any accidents?" he asked.

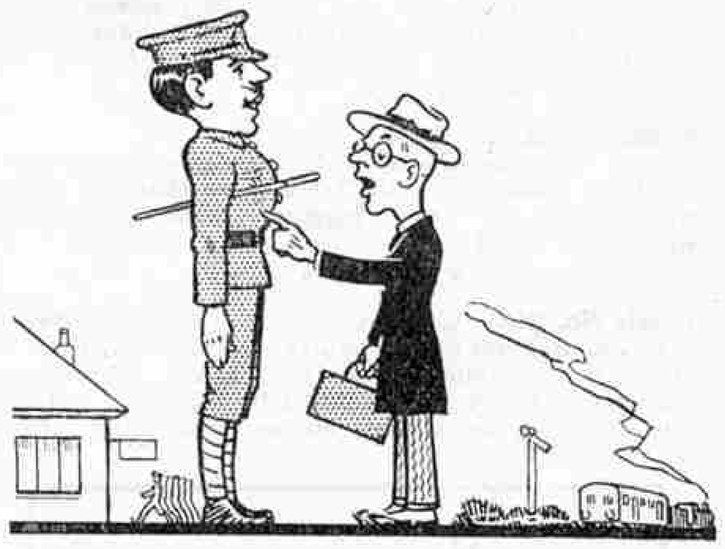
"Naw," said the cowboy. "Once a horse kicked two of my ribs in, and once a snake bit my ankle—that's all."

"But, good heavens!" said the agent, "don't you call those accidents."

"Naw. They did it on purpose!"

* * * *

THE HUSTLER



A man was waiting for a train when his curiosity was aroused by a company of soldiers forming into line along the platform and standing smartly at attention.

Soon an engine drawing one coach rushed through the station at sixty miles an hour. The sergeant then marched the party to the station yard. Wondering somewhat, the traveller buttonholed one of the soldiers.

"Say, was some eminent person travelling by that train?" he asked.

"There was that," replied the soldier, "Did you see that fellow hanging out of the window with a notebook in his hand? It was the battalion tailor measuring us for our new uniforms!"

GONE FOR GOOD

A man entered the vestibule of an hotel and placed his umbrella in the stand, but before going upstairs he tied to the umbrella a card on which he had written: "N.B.—This umbrella belongs to a champion boxer. Back in ten minutes."

In twenty minutes he returned, but the umbrella was gone. The card, however was still there, and on it someone had written: "P.S.—Umbrella taken by a champion long-distance runner. Won't be back at all!"

* * * *

Visitor: "I suppose you all do something to help Mother?"

Elsie: "Oh, yes, it's my turn to count the spoons to-day after you have gone."

* * * *

"Do you call this a pint?" asked the sharp servant girl of the milkman.

"Yes!"

"Well, it won't do. When we want condensed milk we buy it at the grocer's!"

* *

The poor fellow had not paid his rent.

"Look here," said the landlord, 'I'll meet you halfway. I'll forget half of what you owe me."

"Right you are," said the lodger. "I'll meet you. I'll forget the other half."

* *

Doctor: "And do you take exercise after your bath?"

Truthful Patient: "Oh, yes, rather. I generally step on the soap as I get out."

* * * *

HAWKINS, ANCIENT AND MODERN

A couple of cockneys visiting the Royal Academy came to a painting entitled: "Hawking in the Olden Days," and stood gazing at it with great interest.

"'Awking in the Olden Days," said one. "Well, they didn't arf do it, heh! My word! 'Orseback an' all!"

"Rather!" agreed his female companion. "But wot are they 'awking, 'Enry?"

"Blessed if I know," responded the puzzled 'Enry, "unless they're tryin' to sell their bloomin' parrots!"

* * * *

Teacher: "Can any boy tell me the earliest reference in history to a theatre?"

Tommy: "Yes, teacher; we read in the Bible that Joseph was taken from the family circle and put into the pit!"

* * * *

Of all the felt I ever felt I never felt a piece of felt that felt the same as that felt felt when first I felt the felt on that felt hat.

MERE BLUFF

Teacher: "The sentence, 'My father had money,' is in the past tense. Now, Susie, what tense would you be speaking in if you said, 'My father has money?'"

Little Susie: "Oh, that would be pretence!"

* * * *

"How often does your line kill a man?" asked a facetious traveller of a L.M.S. guard the other day.

"Just once," tersely answered the guard.

* * * *

Two coloured men came to the outskirts of a crowd where a politician was making a speech. After listening a while one turned to his companion and asked, "Who am dat man, Sam?"

"Ah doan't know what his name is," Sam replied, "but he certainly do recommen' hisself most highly."

ACCUMULATED SPITE

An English tourist, staying at a farmhouse in Scotland, was told by his landlord one morning to take a gun and go out and "shoot something." A little later, while going down a lane, the gun under his arm, the tourist met a small boy on his way to school.

"I say, my boy," he remarked, "is there anything to shoot around here?"

The boy looked round for a moment, and then answered with eagerness: "Aye, there's the skulemaister comin' ower the hill!"

* * * *

Teacher: "Johnny, you've neglected your geography lesson again! However do you expect to solve cross-word puzzles when you grow up to be a man?"

* * * *

It was his first Christmas party and seeing some of his friends partaking of what seemed to be beautiful coloured fruits, that really were ices, little Johnny thought that he would do the same. Choosing what appeared to be an extraordinarily fine apple he essayed a huge bite. While he was struggling to regain his breath someone asked what was the matter.

"Matter! Good gracious! I thought it was an apple, but it was only a painted snowball!"

* *

"Here is a glass of water—pure, cold delicious water," said the lady of the house to a beggar. "What! You refuse it?"

He shook his head and sighed. "I have to, ma'am," he said. "You see, I've got an iron constitution, and water would rust it!"

* * * *

NOT SO FLATTERING

It was a lesson on punctuation, and Jimmy was lolling asleep at his desk.

"Now," said the teacher, "if I say, 'I must leave, as I have an engagement—By the way, what is the time?' I place a 'dash' after 'engagement,' because the sentence is broken off abruptly."

At that moment she caught sight of Jimmy.

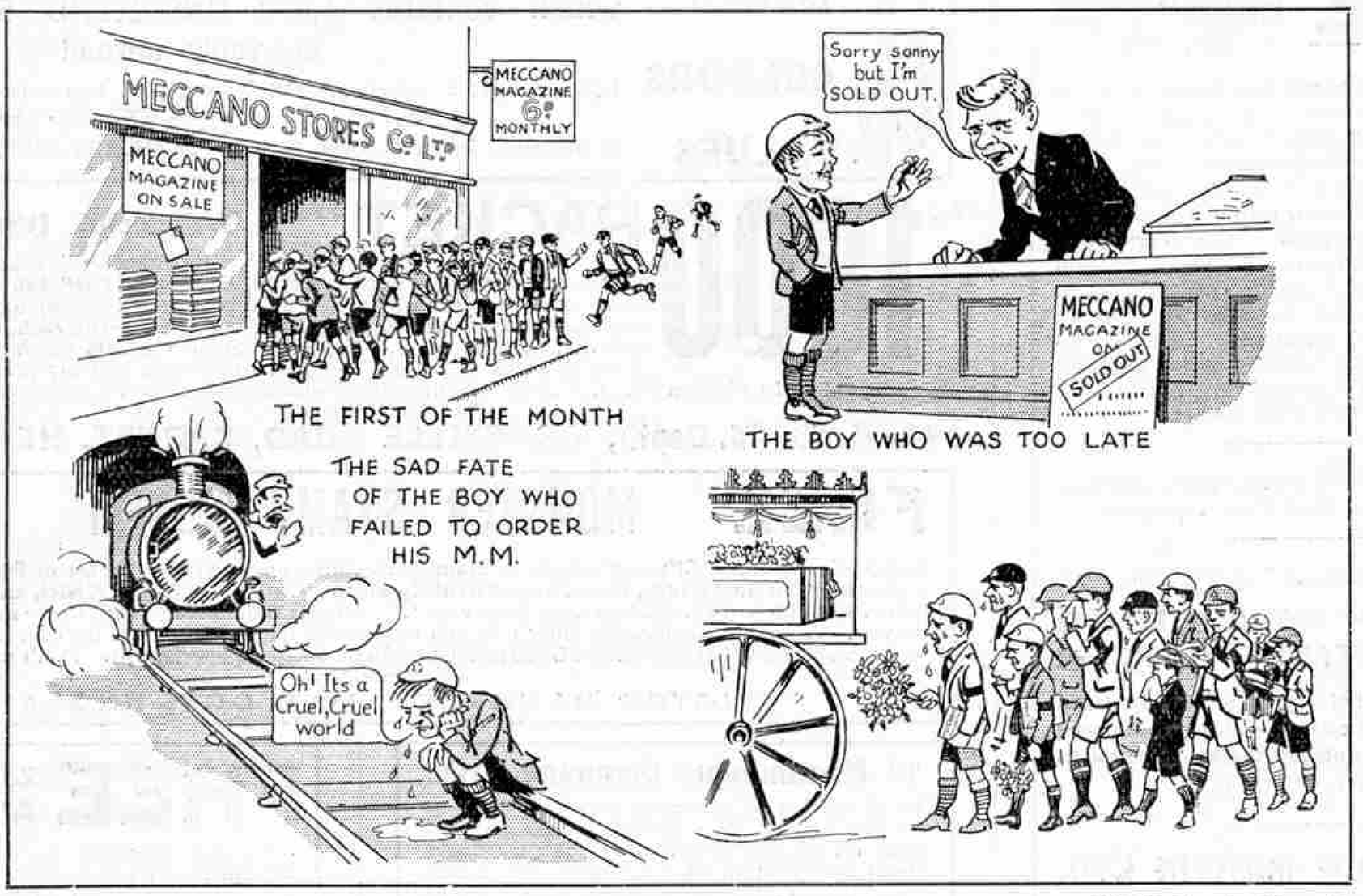
"Now then, Jimmy, you are not listening! What was I saying?" she asked him.

"Please, Miss Smith," said Jimmy, with a start, "you were telling us you said 'dash' because your engagement was broken off abruptly!"

* * * *

Mistress: "Why are you cleaning the silver with Jack's '*M.M.*'?"

Maid: "Well, I heard Jack say his Magazine brightened things up, so I though I would brighten the silver with it."



Drawing] [*H. H. Standen (Hunts.)*

An Awful Warning

Mr. Gasbag Jones stood on a soap-box at the corner of the street. A huge crowd surged around him. Surely his heart should have been glad! But he was dissatisfied. Every attempt he made to speak was interrupted by some member of the audience. At last, stamping his foot in anger, he bellowed at the top of his voice:

"Every time I open my mouth, a silly fool speaks!"

And at last the crowd cheered.

* * * *

TRIUMPH OF ART

A woman entered the shop of a bird stuffer. In her hands was a stuffed parrot.

"Do you remember," she asked, "the bird you stuffed for me last Autumn? Well, the work was done so badly that the feathers are simply falling out."

"That, madam," replied the bird stuffer, "is a triumph of art. We stuff our birds so well that they moult at the right season!"

* * * *

Q. If a man saw his sister fall into a well, why could he not rescue her?

A. Because he could not be a brother and assist her too.

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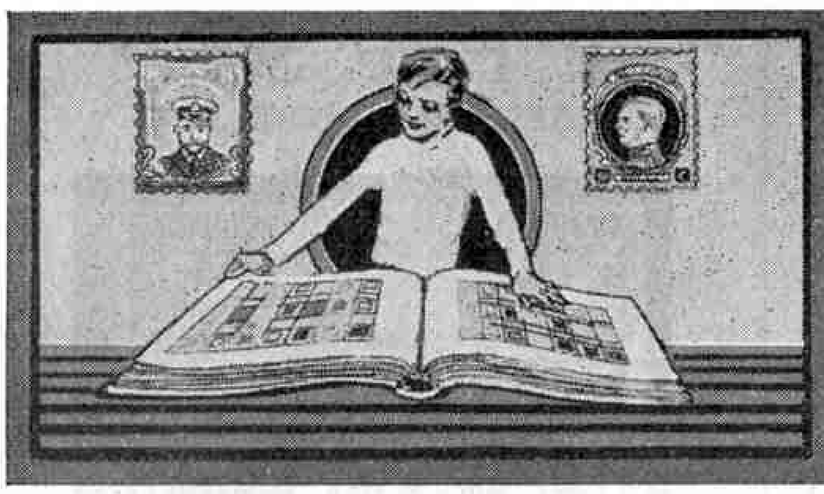

Stamp Collecting

THE FORMATION OF THE UNITED STATES

By R. Kay Gresswell

AS was the case with Chili, whose struggle for independence we described in the October 1926 "*M.M.*," the North American colonies of England were forced into revolt by oppressive rule. There was the difference, however, that while Chili had been restricted in its actions continuously from the beginning of its colonisation, with North America it was a case of sudden restrictions, following a hundred and fifty years of neglect, arousing the inhabitants to indignation.

The first English attempt to form a settlement in America was made by Sir Walter Raleigh in 1583, but this was unsuccessful. The first settlement to be permanent was in 1607 when the London Co. planted a settlement in Virginia. Various other districts were then rapidly occupied in turn by different groups of people. In this way New Hampshire, Massachusetts, Maryland, Connecticut, Rhode Island, Caroline, New York, New Jersey, Pennsylvania and Georgia were formed in turn, the last being in 1733.

These colonies continued to grow as time went on and they roughly may be divided into three groups :—those in the south, occupied by settlers who cultivated tobacco ; those in the middle, largely settled by Dutch and Germans ; and those forming the New England states further north. The inhabitants of these latter states were strongly Puritan both in origin and thought.

The Stamp Act

The first action on the part of England that interfered with the American colonies was the passing in 1765 of the Stamp Act making it necessary for Americans to stamp various legal documents, the proceeds of the tax to be used on the equipment and maintenance of a colonial military establishment. Some of the colonies objected to the imposition of this tax on the grounds that they were not represented in the English Parliament that passed it. So strong were the objections that the Act was repealed. At the same time, however, another Act was passed stating that the English Parliament had full right to pass laws of any kind concerning the colonies, even although they were not represented in Parliament and had no voice in the matter.

Two years after the passing of the Stamp Act another Act was passed concerning the American colonies. This enacted that an import duty should be imposed on various commodities going into America. By this Act the Americans would have to pay the English Government a certain amount of money every time any dutiable articles entered the country. The object of this tax was not to regulate trade, as is usually the case with import duties, but was merely for the purpose of raising revenue for the home government.

These taxes were naturally resented by the colonies and in 1770 all were abolished excepting the tax on tea, and three years later this was removed in certain cases.

The leading American political party had adopted as a slogan the phrase " No taxation without representation " and they suspected that this partial removal of the taxes was an attempt to make them abandon this principle. To show that they were not to be deceived by such actions, some Americans dressed up as Indians boarded some teaships in Boston Harbour and emptied all the tea into the sea.

This was the first act of actual defiance of English authority and stern measures were taken by the English Government to bring the colonies under control. Boston Harbour was closed, the charter of the Massachusetts colony was annulled and martial law brought into action throughout the colony. New Englanders were annoyed by the government statement that Roman Catholicism was to be the official religion of Canada.

Events now moved rapidly. The colonists at once began to resist these new measures of oppression. A force of militia was formed, the members being called " Minute Men " on account of the fact that they had undertaken to turn out at a minute's notice. The statue on the green at Lexington of a minute man was pictured on the 5c. value of the Lexington Concord commemorative stamps issued in 1925.

At the First Continental Congress held at Philadelphia, all the colonies except Georgia supported Massachusetts, claiming self-taxation, the right to be represented in the English Parliament, and so on.

Independence Declared

The small village of Lexington, Massachusetts, the scene of the first shot of the civil war, is now illustrated in our stamp albums by the 2c. value of the 1925 commemorative series that also pictures the minute man.

On the 18th April 1775, eight hundred English soldiers were sent from Boston to Concord to destroy military stores that had been collected there by the rebels and also to arrest John Hancock and Samuel Adams who were at Lexington. When the force arrived there it found over sixty minute men drawn up in fighting array on the green and when they refused to disband, the English fired two volleys, withdrew and proceeded to Lexington, leaving eight Americans dead and nine wounded. This was the beginning of open hostilities and on the way back from Concord the English troops were fired on during the whole march by small bands of men. The whole countryside was aroused and the English were in serious danger of being totally defeated when they were rescued by a force of a thousand men from Boston. The losses that day were—English, 73 killed, 174 wounded and 26 missing ; Colonists, 49 killed, 39 wounded and 5 missing.

There were several other encounters and on the 4th of July, 1776, the Declaration of Independence was issued by the Second Continental Congress. George Washington was at that time the commander-in-chief of the rebel army and the other leaders were Benjamin Franklin, Patrick Henry and Samuel Adams.

This did not bring the war to a close, and it was not until five years later that America became free, when Lord Cornwallis, in charge of the English forces, surrendered to the American forces at Yorktown, Virginia.

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Postage Extra.
Many other sets available.
Fine selections of all Foreign countries sent on approval. Can supply all current issues of **French Colonies** at the following rates:—1, 2, 3, 4, 5c at ½d. each; 10 and 15c at ½d. each; 20, 25 and 30c at 1d. each; 35, 40, 45, 50c at 1½d. each; 75c at 2½d.; 1 Fr. at 3d.
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QUALITY PACKET FREE
To applicants for my famous ½d. approvals. 100 different Stamps, including B. Colonials, S. American, Chinese, etc. Without approvals this packet may be had for 6d. post free.— **S. H. Fleming, St. Winifreds, Christleton Rd., Chester.**

A Fine Series

FRENCH EXHIBITION ISSUE

During the past few years France has issued several interesting novelties, such as the Pasteur, the Ronsard and the Olympiad commemoratives already described in these pages, but her latest commemorative issue, while probably fulfilling its purpose by advertising the International Exhibition of Modern Decorative Arts held at Paris last year, leaves much to be desired in the artistic sense. The stamps have been the subject of much discussion in the various stamp journals, for apart from their style of art stamp collectors have had considerable difficulty in understanding the meaning of two of the four designs.

There were six varieties as follows: 10c., yellow and green, showing, as illustrated, a metal vase radiating rays of light and supposed, it is thought, to typify

broadcasting; 15c., green and greenish blue, showing a vase on which is inscribed the name of the exhibition; 25c., brown-lake, showing a potter at work decorating a vase. This is quite a good design and finer engraving would have made it a handsome stamp. Another 25c., mauve and blue, showing a garden design; 75c., ultramarine and very deep green, of the same design as the first 25c.; another 75c., pale and dark blue, same as the 10c.

All are perforated 14 on the long side and 13½ along the short side irrespective of which are the top and bottom and which the sides. The potter design was by E. Becker, being engraved by A. Mignon, and the garden by L. Fluet and H. Papin.

AFRICAN AND ASIATIC
BRITISH COLONIALS ONLY.
Seychelles, Gambia, Kedah, St. Helena (pictorial), Kelantan. These new British Colonials with 15 other good Asiatic and African British Colonials —Price 3d. to Bona-fide Applicants for selections on approval only.
TURNER, 162, East Hill, London, S.W.18.

George Washington

Undoubtedly the leader of the American people, at least during the middle and later portions of the rebellion, was George Washington. The respect with which the United States remembers this has been shown in one way by the prominence with which Washington has figured on the stamps issued by that country.

On the 5th August, 1847, the first stamps for general use throughout the States were issued and a portrait of Washington appeared on the 10 cents value. He appeared on five values of the 1851 series, five of the 1861 (the 10c. of which is illustrated here) and so on. There has never been any series of ordinary postage stamps, other than commemoratives, issued by the United States of America in which George Washington has not been figured. Besides the one already mentioned we illustrate here the 2c. value issued in 1903, and the 2c. of the current series first issued in 1922. We also illustrate a portrait of Martha Washington, whom he married in January 1759.

Washington was born in Virginia on the 22nd February, 1732, nearly two hundred years ago. His early life was much the same as that of any other boy and most of the popular stories about him, such as the hatchet and the cherry tree, never actually took place.

He left school when fifteen and lived with his half-brother Lawrence at Mount Vernon, his father having died four years earlier. In the following year Washington was employed as surveyor of a large property and shortly afterwards became a public surveyor.

About the end of 1753 he was appointed lieutenant-colonel of a Virginian regiment. In this capacity he took part in the French and Indian war and a year later was appointed colonel on the staff of General Braddock. He continued in the army with great distinction until 1758, when he resigned his commission owing to his poor health. He returned to a quiet home life at Mount Vernon, which had now become his property.

On Entering Politics

He was one of the seven delegates sent by Virginia in 1774 to the First Continental Congress, already mentioned, and with it he began his political career. In the following year he attended the Second Continental Congress in the same capacity as before, and, the fighting having now begun, he was unanimously appointed commander-in-chief of the armed forces.

How Washington reorganised the army, planned attacks on the English, and carried them out, we have not room to tell. It is sufficient to say that he proved himself a most able general without whom the result of the war would doubtless have been very different.

In 1783 he returned his commission to Congress and once again attempted to retire to Mount Vernon, although he carried on a very wide correspondence on state matters with all the important people and was in reality more powerful now than ever before. He was present as a delegate from Virginia when the Federal Convention met at Philadelphia in May 1787 to draw up the new constitution. He was elected chairman and in due course was unanimously elected the first President of the United States, concerning which we shall have more to say next month.

Commemorating America's Liberation

Besides portraits of George Washington and his wife, we illustrate several other stamps. The 14 cents of the 1922 issue shows a portrait of an American Indian. This stamp is coloured indigo and it is one of the most handsome stamps that has ever been issued. The 15 cents of the same series, showing the Statue of Liberty in New York harbour, a monument intended to typify the spirit that made it possible for the leaders of the country to break away from the mother country when her rule became intolerable.

The map of the United States, issued a few months ago, is also an excellent example of the stamp designers' art. The rivers and the mountains of the continent are shown in detail, the Mississippi with its tributaries reminding one of a tree with its branches. The 2 cents stamp issued late in 1926 is also a worthy member of our stamp albums. It celebrates the sesqui-centennial exposition held to commemorate the 150th anniversary of the Declaration of Independence at the Second Continental Congress in 1776. The bell that figures as the central feature of the design is to be found at the head of the stairway in the Independence Hall in Chestnut Street, Philadelphia. It was in this building that the Second Continental Congress was held, where Washington was appointed commander-in-chief, and where Independence was declared. The bell is supposed to have been the first to announce the adoption of this declaration and on it is the inscription: "Proclaim liberty through all the land unto all the inhabitants thereof." It has been badly cracked since 1843 and has now little sound.

Lastly, there is the portrait of Nathan Hale, the hero of the war, who was used as the subject of the ½ cent value of the present series, although it was not issued until 1925. Hale, who was born in 1756, offered to enter the British lines disguised as a school-teacher. He was caught, however, and hanged in accordance with military law, by the British, being then only in his twentieth year. This greatly angered the Americans and Hale was looked upon as a sort of martyr.

A similar instance occurred four years later when the Americans caught and executed Major André, a British officer, who entered an American camp to negotiate with the treacherous General Arnold. Major André's fate likewise occasioned great indignation, this time among the British, although in this case also the execution was fully in accordance with military law.

Look Out for These Stamps

New Zealand has just issued two new stamps that bear an extremely bad likeness of the King. It is stated that this is the worst representation of the King that has ever appeared on a stamp, and there is a growing demand that they should be withdrawn. "We should not be surprised if they are withdrawn from circulation in a very short time," said a representative of Messrs. Whitfield, King and Co., the Ipswich stamp dealers. "These are the first stamps of more than 1s. in value that have been issued since 1898, the old Queen Victoria stamps continuing in use, and now that they have issued a 2s. and a 3s. bearing the "likeness" of King George they have used this deplorable design."

The 2s. value is printed in blue and the 3s. value in mauve. The King is shown in admiral's uniform. From a collector's point of view these stamps are likely to be valuable, as if they are withdrawn they will become very scarce.

The Standard Catalogue 1927

This catalogue, published by Whitfield King & Co., contains 5,700 illustrations drawn exactly one quarter the size of the original stamps. The catalogue is now in its 26th edition and is found of great use by those who do not specialize, for it does not discriminate between minor varieties. It is an ideal catalogue for the beginner and young collector.

The present edition is notable for the record number of additions which necessitate no fewer than 35 extra pages. Many of the countries have been considerably extended and revised and the catalogue has been improved in many respects.

The publishers state that the total number of stamps issued to date, as included in their catalogue, is 45,378. Of these Europe has issued 13,552, Asia 8,559, Africa 10,394, America 7,522, West Indies 2,917, and Oceania 2,434. During the past twelve months 2,099 new stamps have been issued.

The interesting announcement is made that the next edition of the "Standard Catalogue" will be published in October or November of this year. The catalogue costs 6/- and further particulars will be sent on application to the publishers, whose address is Ipswich, Suffolk.

Recent Issue

GERMANY

The Inventor of Postcards

The International Postal Union was founded at Berne in 1874 largely through the efforts of Dr. Heinrich von Stephan who was also the chief organiser of the Prussian postal system. To commemorate the jubilee of the existence of the Union, Germany issued a series of four stamps in 1924, showing the portrait of Dr. Stephan. The two lower values show the letters "pf." between the figures of value as in the illustration, but the two higher values have a posthorn in this position instead.

Stephan was born in 1831 and at the age of sixteen entered the service of the Prussian post office. He soon obtained promotion owing to his great ability and to his mastery of several European languages. In turn he represented Prussia when arranging a postal treaty with Spain and Portugal, and reorganised the postal service of Schleswig and Holstein, and of Thurn and Taxis. In 1870 he became postmaster-general of the North German Confederation, and in the following year of the German Empire. In 1878 his office was raised to the rank of Secretary of State.

He was the inventor of postcards and for that alone he would deserve to be remembered, and, as we have already stated, he was the founder of the International Postal Union in 1874. He died in 1879 from the effects of an operation necessitated by blood poisoning.

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THESE few things can give but a faint idea of our gigantic stock of good things. For we have made a special study of the needs of the Modern Boy and are the Greatest Store in London that caters for Boys in their every Hobby, Sport and Pastime. Write to us about it and we will send you post free full particulars of "Your Wants."

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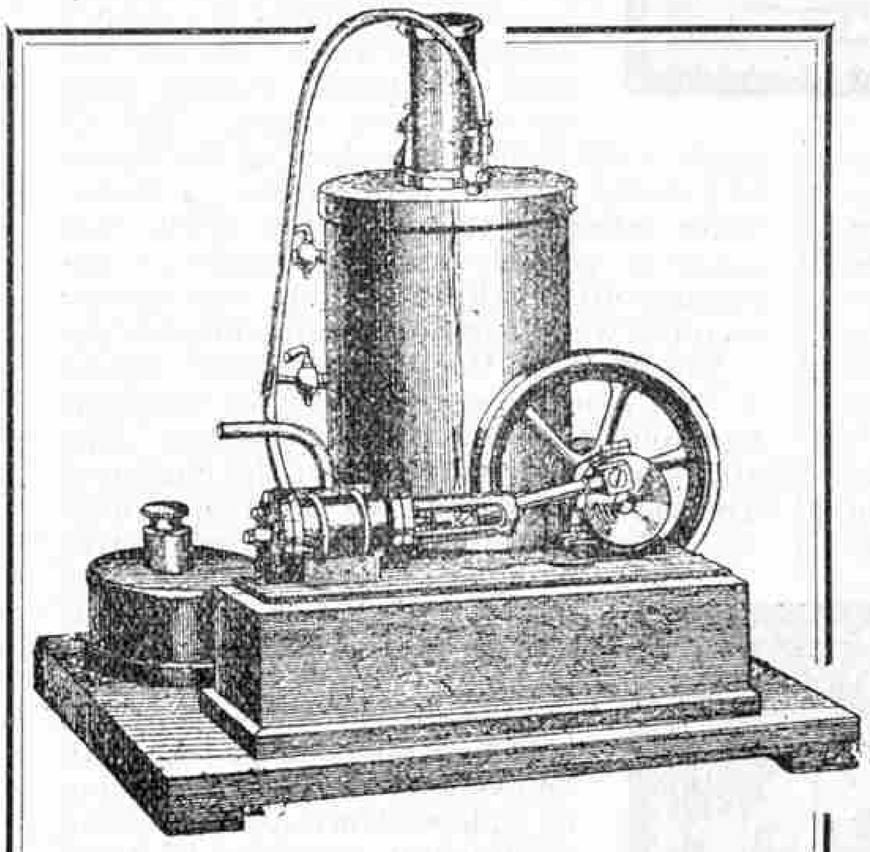
A fine Hobby for the long winter evenings and one of which you will not quickly tire. It is amusing, interesting, and very educational. The modern schoolboy will find it extremely useful for improving his knowledge. You have a choice of a large range of outfits if you come to GAMAGES. Other Sets **3/3**, **14/6**, **32/6**, **52/-**. Post 6d. **5/6**



The HOLBORN HORIZONTAL ENGINE BOILER

A very popular Model, fitted complete with Boiler, similar to illustration. Horizontal double-action slide-valve cylinder, with trunk guide, steel connecting rod and crank shaft, disc crank, heavy flywheel and three-speed grooved driving pulley for round belt. All working parts arranged for lubrication. Bright brass foundation plate, mounted on strong enamelled box, the engine and boiler then being mounted on a polished hardwood base.

No. 1	$\frac{5}{8}$in. bore by $\frac{5}{8}$in. stroke	...	**47/6**
,, 2	$\frac{3}{4}$,, ,, $\frac{3}{4}$,, ,,	...	**56/6**
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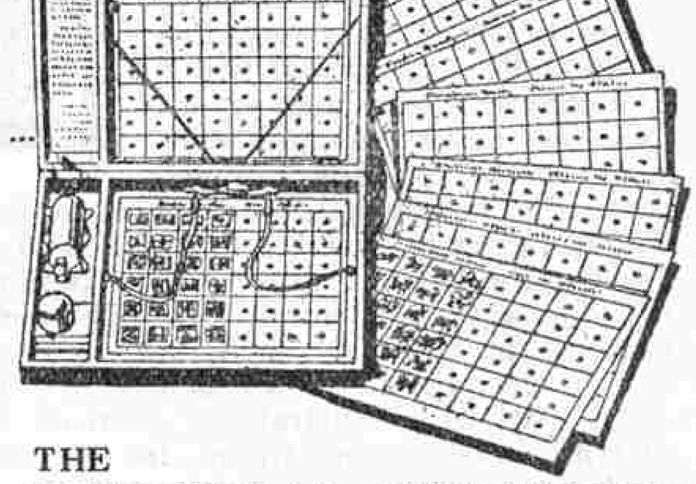
Postage free. Above finished nickel-plated, 15/- extra.



THE ELECTRICAL QUESTIONER

Game asks you questions, puzzles you, and then with a loud B-U-Z-Z tells you the correct answer. acquaints you with birds, beasts, fish, butterflies of all nations. Hundreds of questions and answers and reproductions in full natural colours that open the door to the realm of nature.

The Questioner is operated by a single flashlight battery, which is furnished, and the cards which come with it cover the following list of subjects: General Information, History, Geography, Characters in Literature, Discoveries, Inventions, Famous Men and Women, and Coloured Cards of Song Birds, Fish, Wild Animals, Game Birds, Native Animals, Butterflies, Dogs and Flags. Price **17/6**

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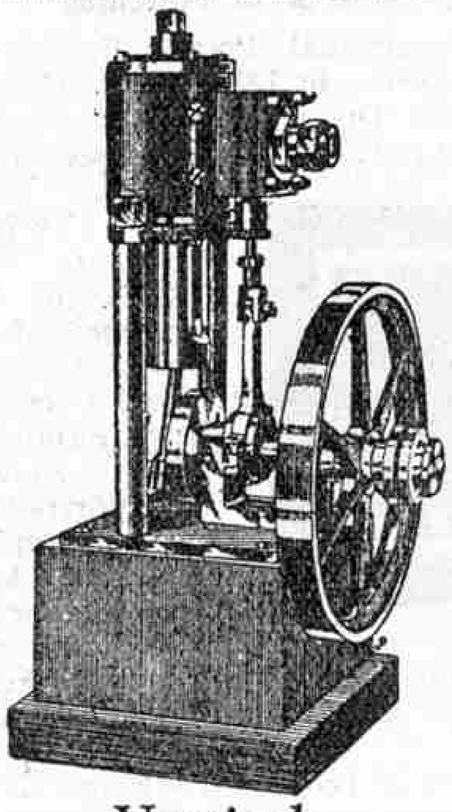
We stock all Hornby Train and Meccano Parts.



Vertical High-Speed Engine

As illustration. Fitted with double-action slide valve cylinder, trunk guide, steel connecting rod and crank, shaft disc crank and very massive flywheel. Three-speed pulley for round belt. All parts arranged for lubrication. The bed plate is of solid brass and extra heavy, and is mounted on a stout wooden block.

No.	Bore.	Stroke.		Price.
1.	$\frac{5}{8}$ in.	$\frac{5}{8}$ in.	...	**22/6**
2.	$\frac{3}{4}$,,	$\frac{3}{4}$,,	...	**27/6**
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4.	1 ,,	1 ,,	...	**36/-**

Above finished nickel-plated, 7/6 extra

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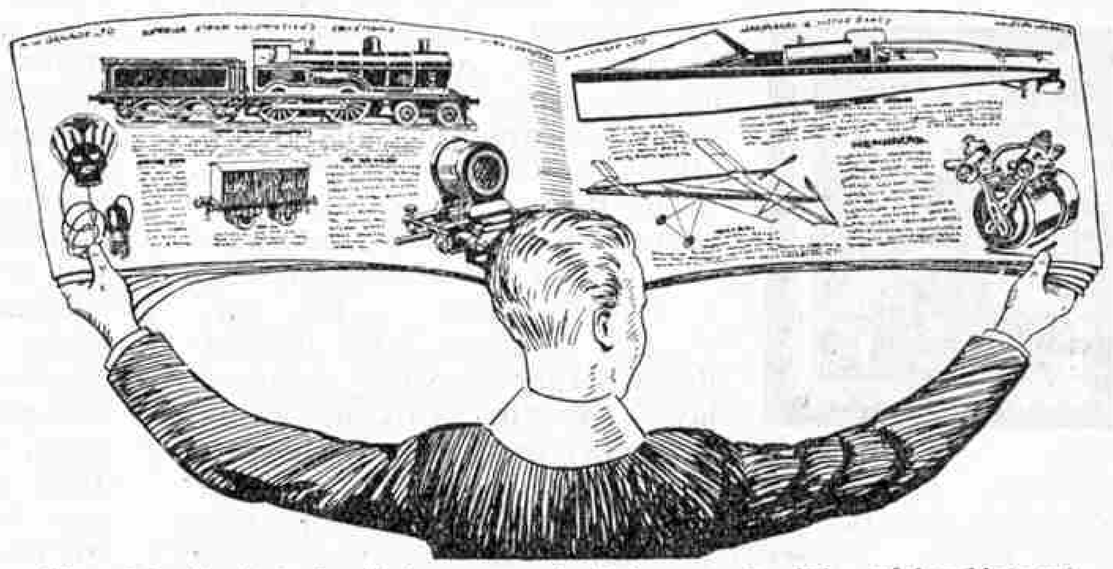
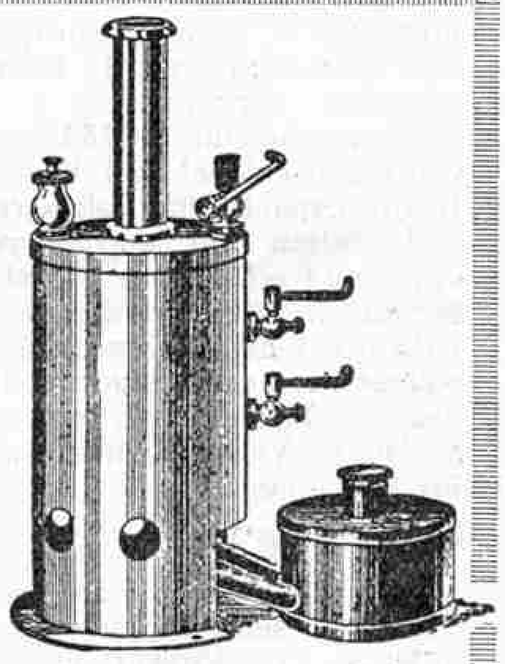


All model enthusiasts should have a copy in their possession, it is useful and interesting. Beautifully illustrated and tastefully set out, and it contains every requirement of a Model Engineer. To obtain it just send us a postcard asking for a copy of

"GAMAGES' AMATEUR ENGINEER"

which will be sent POST FREE ON APPLICATION.



"Referee" Vertical Boilers

Strongly made of stout, highly-polished sheet brass, riveted where necessary. All joints soldered. Fitted complete with main steam cock, safety valve, filler plug, 2 gauge cocks, 2 flame guards and well-made spirit lamp. All boilers are flanged at the bottom and drilled for fixing to base board.

Sizes of Vertical Boilers.

Size.	Height.	Diameter.		Price.
M.	$5\frac{1}{4}$in.	3 in.	...	**18/6**
N.	6 ,,	$3\frac{1}{2}$,,	...	**22/6**
O.	7 ,,	4 ,,	...	**28/6**
P.	8 ,,	$4\frac{1}{2}$,,	...	**34/6**

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Can You Locate These Words?

Fourth Stamp Competition

THIS month's Stamp Competition is, perhaps, a little more difficult than those we have had before, but our readers have proved themselves so successful in solving our problems, that we are sure they will be able to tackle this one quite well.

In the accompanying panel there are 20 words or phrases that appear on twenty postage stamps and you must try to find out what countries issued the various stamps.

None of the words is taken from stamps issued since 1924 nor is any taken from very old or rare stamps, so that all will have an equal chance of being able to solve the problems. Also none of the words is in particularly small type on its stamp and all are quite easily readable in the illustrations in the writer's catalogue. As usual, catalogues may be used in solving any difficulties that arise, but no other help, either from other books or people, is allowed.

The first prize, which will be awarded to the sender of the correct or most nearly correct solution, consists of stamps to the value of one guinea to be chosen from advertisements in this issue of the "*Meccano Magazine.*" The second prize is stamps to the value of half a guinea, and the third, stamps to the value of five shillings.

When you have solved the competition to the best of your ability, make a list of the countries in the correct order, add your name and address and the list of stamps you choose, and post so as to arrive here before 28th February.

1. **Justice, Commerce, Freedom.**
2. **Puerte y Casa de los Virreyes.**
3. **Niet bestellen op Zondag.**
4. **Nadie la apagara.**
5. **Freie Stadt ——.**
6. **Droits de l'homme.**
7. **Centenario de la incorporacion del partido de N——.**
8. **Lord Byron.**
9. **III. Centenario di propaganda fide.**
10. **Commission Interalliée.**
11. **Beira.**
12. **Pro Juventute.**
13. **Signing of the compact.**
14. **Republica Mayor de Centro America Estado de el ——.**
15. **Batalla de Ayacucho.**
16. **Him that found the new isle.**
17. **IIIe Centenaire —— (British colony).**
18. **The love of liberty brought us here.**
19. **Tercentenary of establishment of representative institutions.**
20. **1822, Pioneers landing, 1922.**

In locating the countries of issue it will be a considerable help if readers try to decide to what languages the various phrases belong. There are a number of British phrases, of course, but this does not necessarily mean that these are from stamps of the British Empire, in the same way as a foreign phrase is by no means necessarily from a foreign stamp.

In the cases of mottoes, etc., a foreign language is normally used, but in the cases of statements concerning the use, etc. of the stamps the native language will probably be used.

You will notice that a dash figures in Nos. 5, 7, 14 and 17 and this indicates that here a word has been omitted, that, if it were inserted, would probably locate the origin of the phrase immediately. In the case of No. 7 we give the initial letter of this word as a little help, and in No. 17 we note that the government of a certain British Colony is responsible for its issue, although, we may add, it is not the name of the colony that is the omitted word.

We think, personally, that Nos. 3, 5, 8, 11, and 16 will be found the easiest to solve, for these are perhaps the best known in the list to stamp collectors generally.

Care should be taken with No. 5, however, for there is another country with a somewhat similar inscription. By the way, No. 14 has nothing to do with mayors, nor has No. 4 anything to do with asparagus!

December Stamp Contest

We cannot, unfortunately, comment at any great length on the competition as the Overseas Section is still open and any slight hint given now might materially influence some of the entries from European competitors to the disadvantage of competitors from the more distant parts of the world.

On the whole the competition proved even more popular than that held in September, although the second and last items presented difficulty to a considerable number of entrants.

The prizes were awarded to the following competitors:—1. COLIN MCCAIG (Willaston, Birkenhead); 2. N. G. PEARL (Enfield); 3. D. RATHIE (Bradford).

Stamps Valued at £3,000,000

One of the most interesting and valuable collection of stamps ever shown under one roof was admired by philatelists from all over the world at the International Stamp Exhibition held recently in New York. The value of the stamps exhibited may be gauged from the fact that they were insured for £3,000,000.

The Sudan, Russia, the Irish Free State, Baghdad, Barum and Togo all contributed most interesting and beautiful specimens, which aroused widespread interest among visitors. Several Governments exhibited stamps at this Exhibition, among them being Austria, Sweden, Russia and the United States.

It may here be mentioned that American collectors are acquiring many of the most beautiful and valuable stamps of the world. One of their possessions is the unique one cent British Guiana stamp of 1856 (owned by Mr. Alfred Hind). This stamp realised the huge sum of £7,400 at the Ferrari sale and was exhibited in London three years ago.

Southern Railway 4-4-0 Type Locos—

(*Continued from page* 111)

154.5 sq. ft., small tubes 914 sq. ft., large tubes 338.5 sq. ft.

There are twenty-one elements in the superheater, the area of which is 235 sq. ft., the grate area being 22.5 sq. ft.

The wheels are 19½ in. in diameter and the stroke 26 in.

The diameter of the piston valves, inside admission, is 9 in. At 75% cut off the travel of the valves is 5⅜ in. and their lap 1 3/16 in.

The coupled wheels are 6 ft. 8 in. in diameter and the bogie wheels 3 ft. 7 in. in diameter.

The weight on the coupled wheels is 38 tons, the total weight of the loco in working order being 58 tons 10 cwts. The tractive effort at 85% boiler pressure is 8.44 tons.

The tender has a coal capacity of 5 tons and a water capacity of 3,500 gallons. Its total weight in working order is 40 tons 10 cwts.

Famous Trains—(*continued from page* 123)

over the river by two vast spans resting on the one central pier. The chief strength of the bridge lies in the great curved tubes of wrought iron, elliptical in section and hollow, from which the floor of the bridge is suspended by vertical tie-rods. It is a tribute both to the genius and to the foresight of Brunel that this unique structure, opened in 1859, is still in use, carrying the vastly heavier locomotives and trains of to-day.

So the "*Limited*" forges westward past Liskeard, Par and St. Austell to Truro, over stone viaducts that until recently were wooden trestle bridges, through cuttings and tunnels and over reverse curves which, from the footplate, seem almost bewildering in their frequency. Then on through Redruth and Camborne, famous for their connection with Watt and Trevithick, to Gwinear Road, where connection is made to Helston and the Lizard; St. Erth, where the St. Ives coach is jettisoned; and last of all round the margin of Mount's Bay across a causeway from Marazion into Penzance, where we draw up at 5 p.m., exactly as far from London as is the Scottish border north of Carlisle.

So another day's journey of the "*Cornish Riviera Limited*" express has been successfully completed.

The Story of Coal—(*continued from page* 102)

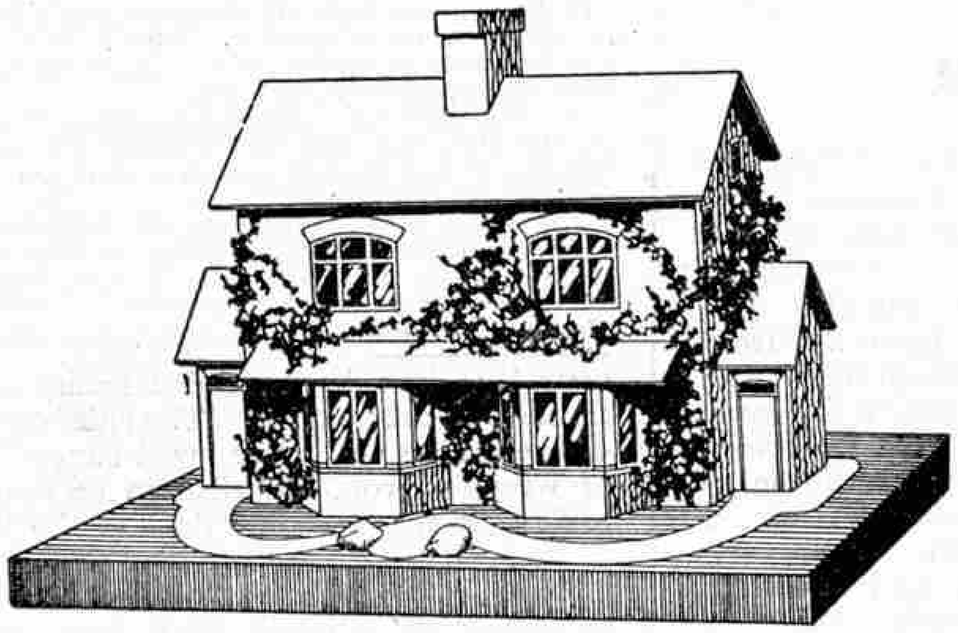
It contains a very small amount of gas and a very large proportion of carbon, and its name is derived from the Greek word *anthrax*, meaning carbon. Anthracite is difficult to ignite and this fact hindered its general adoption for a considerable time. It is perhaps best known for its remarkable steam-raising qualities.

There is also another curious kind of coal known as "*Cannel*" coal. The name is probably a corruption of the word "candle," on account of the fact that it burns with a bright, clear candle-like flame. It is said that at one time pieces of this coal were used as a substitute for candles and torches. In Scotland it is known as "Parrot" coal on account of the crackling sound it makes while burning.

On distillation, cannel coal gives off a large quantity of gas of high illuminating power and it is therefore greatly used in gasworks. This coal has come into greater prominence during recent years on account of the considerable quantity of valuable oils that can be extracted from it by the process known as low-temperature carbonisation, to which we shall refer later.

An interesting form of cannel coal is that known as Jet. This substance is very hard and can be cut and polished with great success. At one time a considerable amount of jet was extracted near Whitby in Yorkshire, and cut into brooches, earrings, beads and other ornaments, which were largely used as mourning jewellery. Jet has been out of favour for many years in this country, although it is still more or less popular in Spain and Turkey.

BUILD A HOUSE! *Special Offer to Meccano Boys*



We offer a limited number of model house sets to readers of the "Meccano Magazine."

Each set is printed on stout card and enclosed in an envelope on which a picture of the made-up design appears.

This envelope is enclosed in a box containing also building base and straight edge together with tube of SECCOTINE and printed instruction sheet.

There are Fifteen different Designs or Models, as follows :

Box No. 1.—Two Semi-Detached Villas.
" " 2.—Detached House, to stand in its own grounds.
" " 3.— ditto ditto ditto
" " 4.—(a) Village School. (b) Two Semi-Detached Villas. (c) Villa.
" " 5.—(a) Church. (b) Blacksmith's Forge. (c) Village Shop.
" " 6.—(a) Villa. (b) Cottage. (c) Village Inn.
" " 7.—(a) Row of Cottages. (b) Detached House. (c) Monument.

In the cases of Nos. 4, 5, 6, and 7, the greater number of Models makes it easy to fit three or more of them together to resemble part of a Modern Village. Very successful results can be obtained with three different boxes.

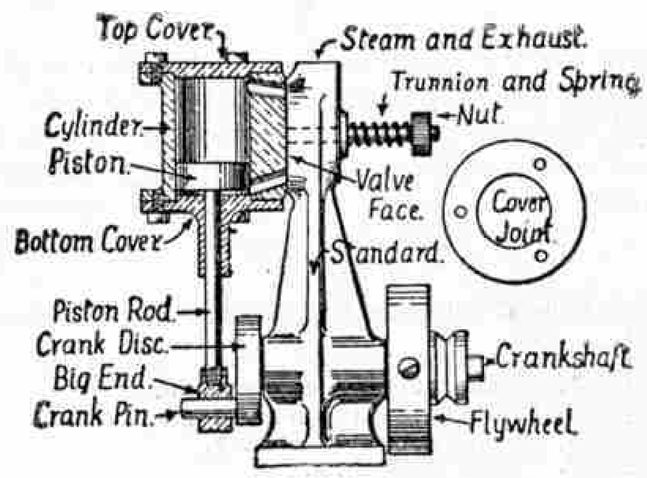
Any box for **1/6**, postage paid.

Mention "Meccano Magazine" when ordering.

M'Caw Stevenson & Orr Ltd., The Linenhall Works, BELFAST

You must have the S.T. ENGINE

to drive your Meccano Models.



This is the drawing which helps you to build the engine.

S.T. Engine Parts 5/–
Finished Boiler 8/–

Post Free.

It is utterly different from the ordinary Toy Shop model engine.

In the first place you have the pleasure of building it yourself.

You need have no fear, we **guarantee** it will work when you have built it.

Secondly, like all Stuart models it is made on correct engineering lines and therefore has **Power.**

The Boiler is of Copper, brazed throughout and tested.

Read what a customer writes :—

" Please send me a trunnion nut for the S.T. Engine purchased from you 3 years ago. It is a grand little engine and is running splendidly. I am telling every Meccano boy I see about it. It drives models at an awful speed."

Send a stamp for list 12M which describes this and several other simple models, or better still a Postal Order for 6d. for our new 80 page Engine catalogue, fully illustrated and packed with interest from cover to cover.

Stuart Turner Ltd., Henley-on-Thames

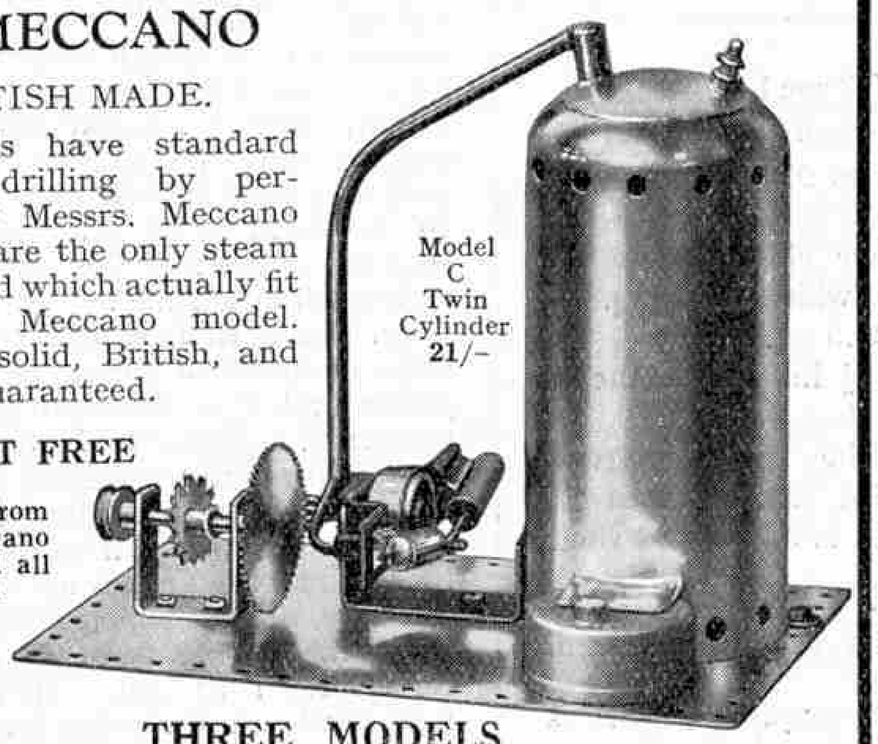
A Puff of Steam! The Roar of an Engine!

Two little things, yet what a difference they make to your Meccano Models! The difference between realism and pretence—between model engineering and toy making!

WORMAR STEAM ENGINES FOR MECCANO

BRITISH MADE.

All models have standard Meccano drilling by permission of Messrs. Meccano Ltd., and are the only steam engines sold which actually fit into any Meccano model. Powerful, solid, British, and guaranteed.



Model C Twin Cylinder **21/–**

FULL LIST FREE

Obtainable from all large Meccano Stockists and all advertisers in this issue.

THREE MODELS

5/11 (post 7d.) Model A. Single cylinder. Height 5 ins., runs 20 minutes.

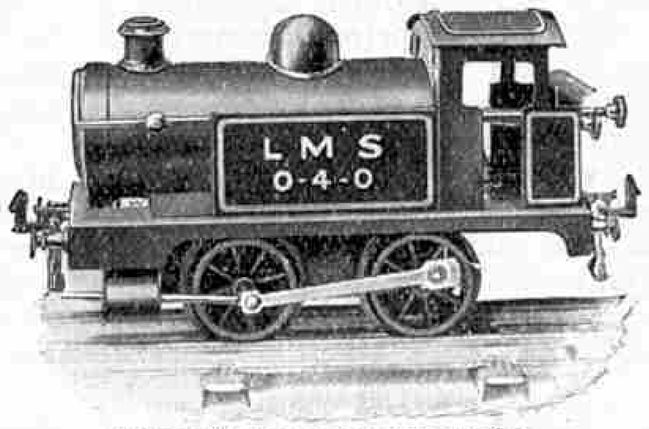
10/6 (post 9d.) Model B. Single cylinder (with gear). Height 5¾ in., runs 30 minutes.

21/– (post 9d.) Model C. Twin cylinder (with gear). Height 7 in., runs 60 minutes (illustrated).

B. and C. have nickel-plated base and geared shaft to take Meccano cogs, etc.

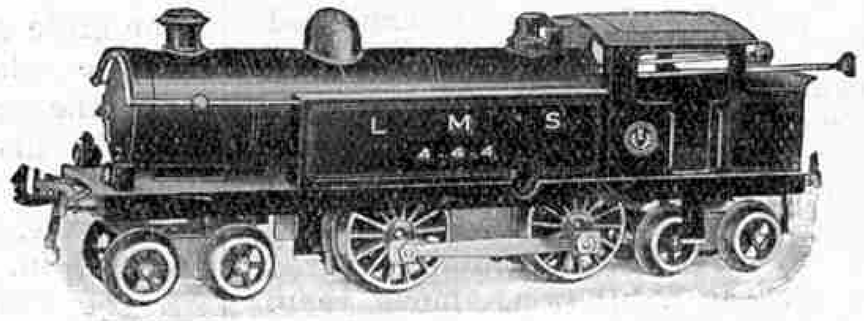
WORBOYS & SMART, 177, KING STREET, LUTON.

HORNBY TANK LOCOS



HORNBY No. 1 TANK LOCO

Strong and durable loco capable of any amount of hard work; richly enamelled and highly finished; fitted with reversing gear, brake and governor.
Gauge 0, in colours to represent L.M.S., L.N.E. or G.W. Railway Companies' Locos ... ... Price **12/6**



HORNBY No. 2 TANK LOCO

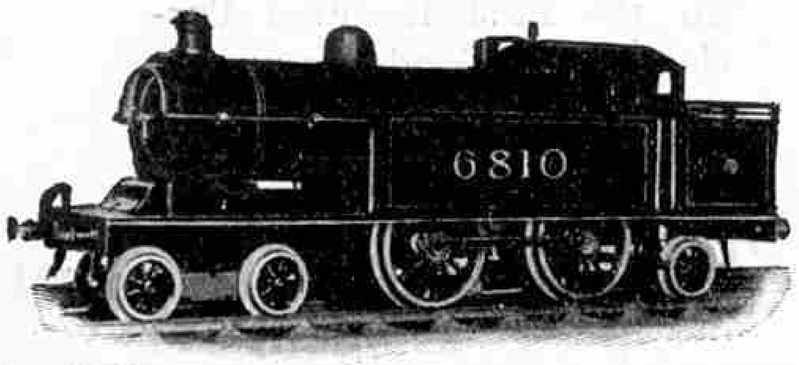
Powerful model embodying all the characteristics of the Hornby series. It is 10½" in length and is fitted at both ends with a four-wheeled bogey. Beautifully finished in colours to represent L.M.S., L.N.E. or G.W. Railway Companies' Locos, and suitably lettered. Fitted with reversing gear, brake and governor. Suitable for 2 ft. radius rails only. Price ... **30/–**

FROM ALL MECCANO DEALERS

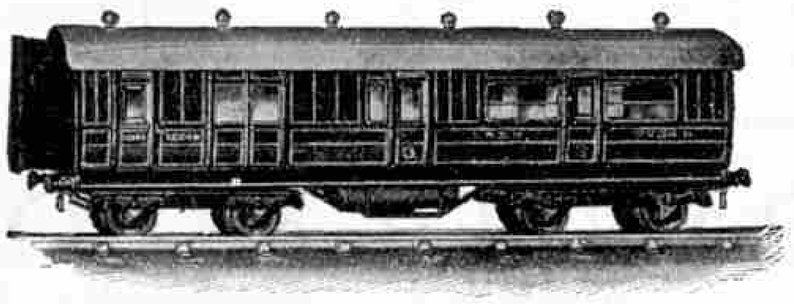
Our Model Railway Catalogue Section A/17

Features a number of entirely new lines, contains complete descriptions of our huge stock of locomotives in all gauges—propelled by electricity, steam, or clockwork—rolling stock of all kinds, permanent way and parts, stations, buildings, signals—in fact, everything you can possibly need on a model railway. Over 180 pages, excellently printed, with authoritative matter relating to prototypes and other railway matters; truly a magazine in itself, and, most important—**MANY REDUCED PRICES.**

Here are some specimens of our models—taken at random from stock. If you cannot pay a personal visit of inspection, you really *must* have a copy of this new list; all descriptions are thoroughly reliable, and you may order from the Catalogue with every confidence.



L.M.S. Tank, 4–4–2 type; supplied in gauges 0 or 1. Electric or Clockwork. Gauge 0. Price **£3 15 0.**



L.N.E.R. Brake-Third Coach, with Corridor Connections; also supplied in the new L.M.S. Colours. Gauge 0. Price **15/6.**

Get *your* copy right away; it costs 6d. at either of our branches, or direct from our Head Office at Northampton.

Price 6d.
Post free.

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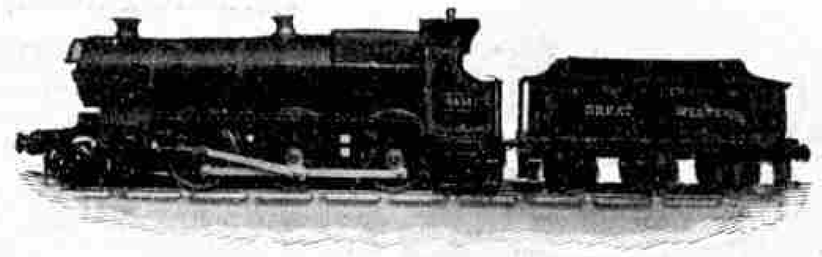
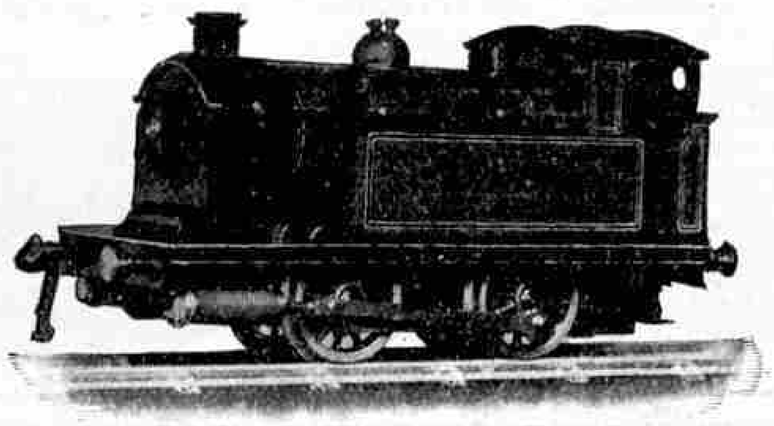


G.W.R. 2–6–0 Locomotive; either electricity, steam, or clockwork. Gauge 0. Price **£5 5 0.**



No. 112. Tank Locomotive, Gauge 0, steam. Price **42/–**; *electric,* **50/–**; *clockwork,* **45/–.**

London Branch:
112, High Holborn, W.C.1

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72	,,	... ...	17/6
100	,,	... ...	42/–

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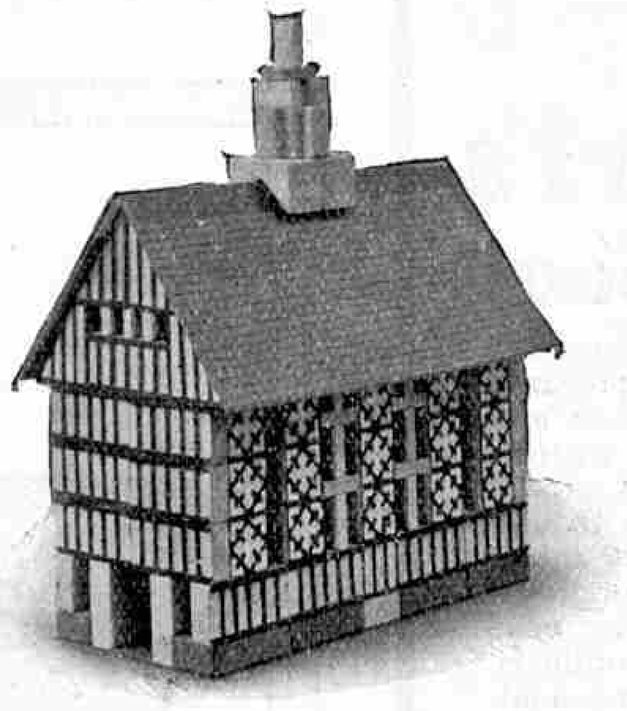

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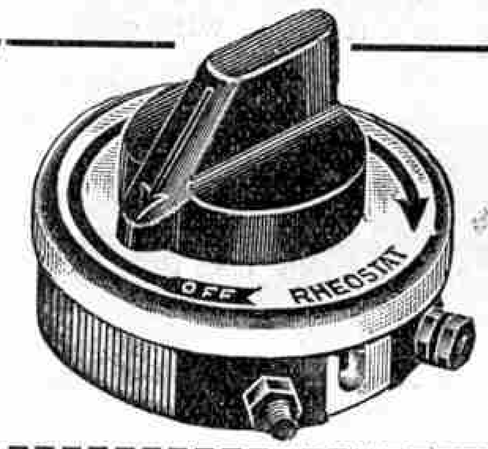
LOTT'S BRICKS LTD., WATFORD, England

RADIO
IGRANIC
ELECTRIC Co. Ltd.
DEVICES

Give the very best results



Igranic-Pacent Porcelain Rheostat

The "Igranic-Pacent" Porcelain Rheostat can be mounted on baseboard or panel and gives smooth, silent filament control over its whole range. A handsome silvered-metal dial and attractive knob is supplied with each Rheostat. Made in resistances of 6, 10, 20, 30 and 50 ohms. Price **2/6** each.

Also as a 400-ohm Potentiometer. Same Price.

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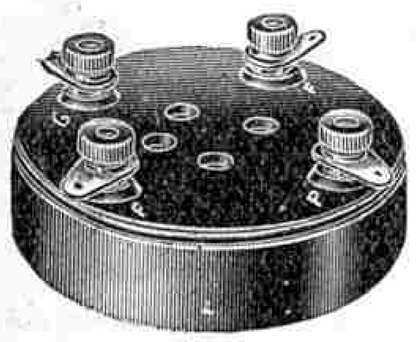
The sockets in Igranic "Nonmic" Valve Holders are suspended by specially shaped metal springs, which give extreme resilience and effectively absorb shocks, thus preventing microphonic noises. The self-capacity of Igranic "Nonmic" Valve Holders is extremely low, making them particularly suitable for short wave reception. Made in two types for panel or baseboard mounting, each type being fitted with soldering tags and nickel-plated terminals, clearly marked, thus greatly facilitating connecting. Price 3/- each.



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Igranic Electric Co. Ltd.

149, QUEEN VICTORIA STREET, LONDON
Works: BEDFORD

For Dirty, Oily, Greasy Hands

TEA-TIME! And hands like a nigger through "tinkering" with that new model. Not just dirty, but oily too. Will ordinary soap get it off?

Calvert's Pumice Soap

is just the thing for occasions like this. Specially prepared with fine pumice powder and other grease-removing ingredients, it is as handy as a toilet soap and just as nice to use. Made in a convenient tablet form, it is a great improvement on having to dig your fingers into a tin of ordinary grease removing compound.

If you find any difficulty in getting it locally

Obtainable from Chemists

3D PER TABLET

Send 3d for Sample tablet (full size) to

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P.O. Box 147
MANCHESTER

100 GIFTS
for MECCANO READERS

To the First Hundred Purchasers of Goods from our Catalogue during February we are giving one of our Famous

Tip-Top Fountain Pens

The usual price of the pen is 5/6.

The value of the purchase must be 5/- or over and each purchaser may receive one Gift only.

SECURE ONE NOW! by Posting your Order at Once.

Catalogues can be obtained by forwarding two penny stamps.

FRANBER & CO.

The Mail Order House

58, BIRCHWOOD CRESCENT
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NULLI SECUNDUS
PASSE PARTOUT
Picture Framing Outfits

Ask for particulars of our Annual Competition. Valuable Prizes.

Decorate your own home with pictures framed cheaply and artistically with Passe Partout. A picture framed with Passe Partout makes a beautiful present.

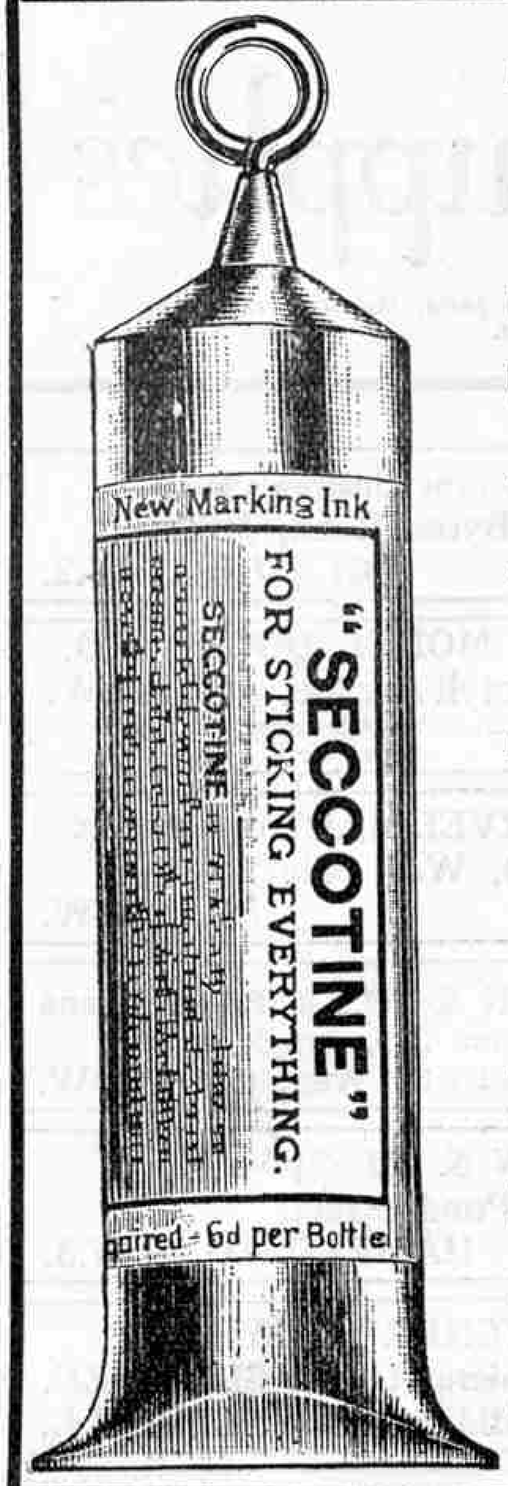
Outfits 2/-, 5/-, 10/- & £1 and all accessories from your local stationer or photographic dealer.

Send to-day for our free instruction booklet.

SAMUEL JONES & CO. LTD.

Passe Partout Makers, Bridewell Place, E.C.4

If your local dealer is out of stock you can obtain Nulli Secundus Passe Partout Outfits and Accessories post free direct from us.



THE MECCANO BOY'S STAND-BY

THE TUBE OF

SECCOTINE

The World's Great Adhesive. Registered Trade Mark.

WITH it he can mend a thousand things—his bats, balls, boats, boxes, bags, books, &c. He can make numberless things that a boy likes. He can help his mother by mending breakages in house furniture, anything—everything.

NOTE. There is nothing messy about Seccotine. Use the spike or pin supplied to open a new tube—at top of cone—press gently at end of tube (at folded part) for as much adhesive as is needed—then replace spike or pin which acts as stopper. Keep folding tube end as contents are withdrawn. Give mended article adequate time for drying.

TUBES are 4½d. (vest pocket box), 6d. and 9d. each. Sold everywhere.

Mothers should know that cups, saucers, tumblers, etc. intended to hold liquids, hot or cold—should be mended with FIRMAS (Heat Seccotine). Tubes 6d. each.

McCAW, STEVENSON & ORR LTD.

The Linenhall Works BELFAST

A REAL FLYING MODEL

British Patents, G.B. 171,499—G.B. 188,523
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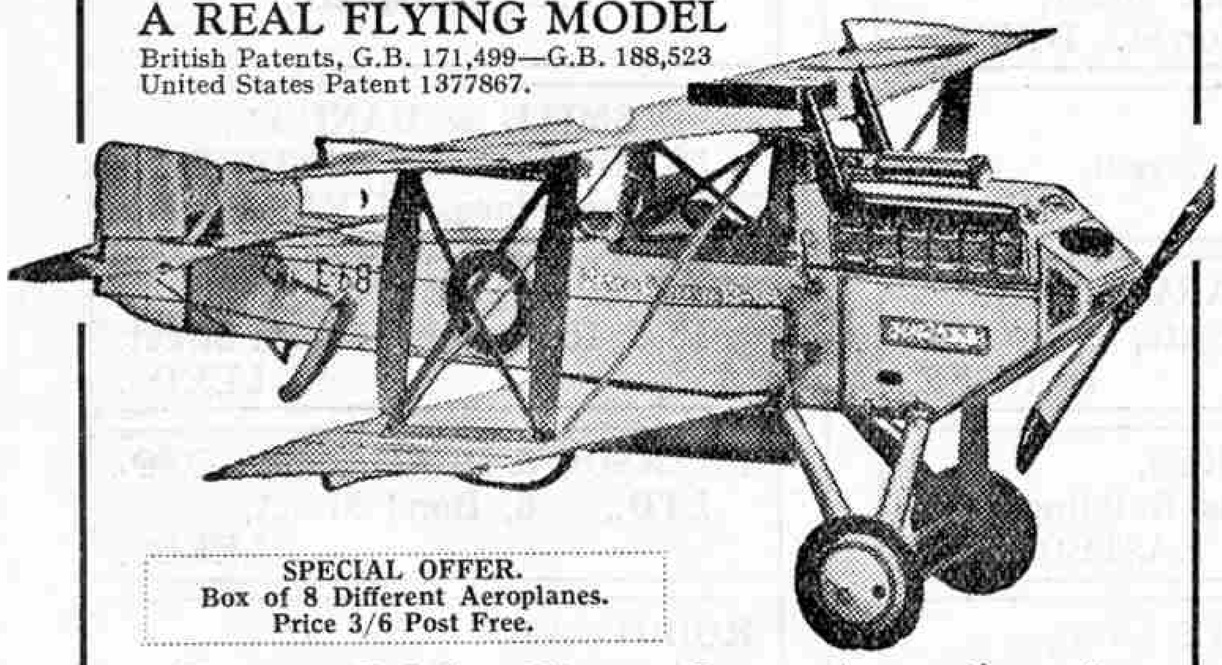

SPECIAL OFFER.
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Price 3/6 Post Free.

Boys! Make Your Own Aeroplane!

Military Biplane, Type E-6879.

The very thing for dark evenings. The model has all the parts and controls that you'll find on the big planes. Elevators, ailerons, machine guns, pitot tubes, windscreens, and even a miniature dashboard with dummy instruments, gauges, etc. Real elastic shock absorbers are fitted to the landing wheels and tail skid. When you have built up the model you can make it do everything that a real 'plane can do. Size of model: Span 12 ins., Length 13 ins.

Complete set of Cardboard Parts printed in colours, together with all necessary Elastic, Wood, Wire, Book of Instructions and Working Drawings.

PRICE 1/- (Post 4d. extra)

Catalogue of other Models. Price 2d., post free.

Send P.O. off to-night to

WILLIAM E. APPLEBY (N/C) & CO.

(Dept. K.), 217, Jesmond Road, Newcastle-on-Tyne.

Keep your Boys at home

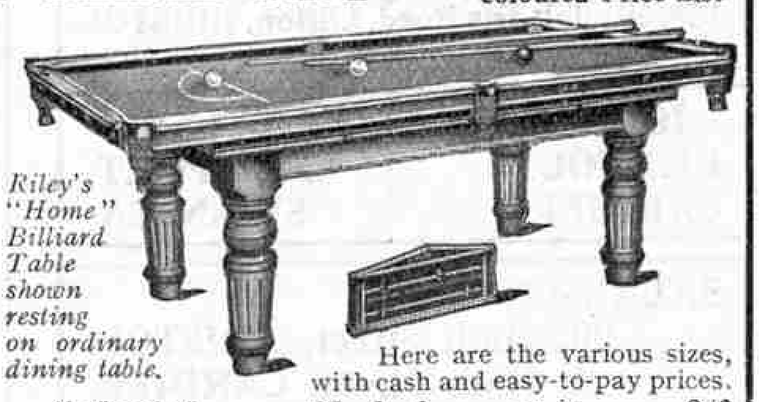
—let them find their pleasures at home on a

RILEY 'HOME' BILLIARD TABLE

7 DAYS FREE TRIAL GIVEN

Write to-night for coloured Price List

14/- DOWN By simply sending a postal order for 14/—you can have the 6 ft. size Riley "Home" Billiard Table—a real billiard table—delivered complete and ready for play. The balance you pay whilst you use the table. **Riley's pay the carriage and take all risk in transit . . .** and 7 days' free trial enables you to test the table before buying. Send your order to-night!



Riley's "Home" Billiard Table shown resting on ordinary dining table.

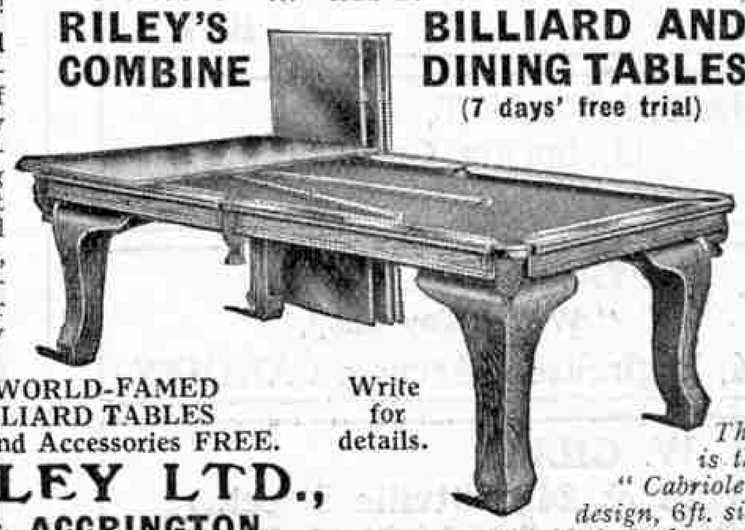
Here are the various sizes, with cash and easy-to-pay prices.

4′ 4″ × 2′ 4″	...	£7	0	0	or in	8/6
5′ 4″ × 2′ 10″	...	£9	0	0	18	11/-
6′ 4″ × 3′ 4″	...	£11	15	0	monthly	14/-
7′ 4″ × 3′ 10″	...	£15	0	0	payments	18/-
8′ 4″ × 4′ 4″	...	£21	10	0	of	26/-

RILEY'S COMBINE BILLIARD AND DINING TABLES

(7 days' free trial)

Riley's Combine Billiard — and Dining Table — a magnificent piece of furniture that, in a few seconds can be converted from a dining table into a perfect billiard table. Supplied in Oak or Mahogany, various shades and designs from £22 10 0 or in 13 or 20 monthly payments.



This is the "Cabriole" design, 6ft. size £34-10-0 Cash, or in 13 or 20 easy payments.

RILEY'S also make the WORLD-FAMED RILEY FULL-SIZE BILLIARD TABLES Estimates for Repairs and Accessories FREE. Write for details.

E. J. RILEY LTD.,

Deal Works, ACCRINGTON, and Dept. U, 147, Aldersgate St., London, E.C.1

Meccano & Hornby Train Supplies

All the dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

ACTON'S SPORTS SUPPLY CO.,
ACTON. EALING.
WIMBLEDON. HARLESDEN.

HARRY BROWN,
1, Moss Lane,
ALTRINCHAM.

J. WOODHALL,
256, Grange Road,
'Phone : B'head 621 BIRKENHEAD.

MERCER'S DOLLS' HOSPITAL,
68, Darwen Street,
BLACKBURN.

SELLEN'S BAZAAR,
54, Waterloo Road,
BLACKPOOL, S.S.

BROWN, MUFF & CO. LTD.,
BRADFORD.

W. CARTER,
15, Bridge Street,
opp. Mechanics' Institute, BRADFORD.

JOHN TAYLOR,
28, Preston Street,
Tel. : Brighton 957 BRIGHTON.

GYLES BROS. LTD.,
Tel. 2888 24, Bridge Street, BRISTOL.
188, Whiteladies Road, Clifton, BRISTOL.
Tel. 143

JOHN HALL (TOOLS) LTD.,
BRISTOL. NEWPORT.
CARDIFF. SWANSEA.

SALANSON LTD.,
20, High Street, BRISTOL.
4, High Street, CARDIFF.

SAM TAYLOR,
Silver Street,
Tel. 320 BURY.

HAROLD HUNT,
38, Spring Gardens,
Tel. 202 BUXTON.

A. M. HARRIS,
"Wilces Toy Shop,"
14, High Street Arcade, CARDIFF.

H. W. GILL,
23 & 24, Pittville Street,
CHELTENHAM SPA.

R. H. JEPSON,
1, Cross Cheaping,
COVENTRY.

PURSEY & MOCKRIDGE,
The Sports Outfitters,
Tel. Dartford 173 DARTFORD.

HENRY WHALLEY,
195, Duckworth Street,
DARWEN.

RATCLIFFES TOYERIES,
19, Osmaston Road,
DERBY.

C. E. MELLER,
"Dolls' Hospital,"
DONCASTER.

JOHN ARCHIBALD,
20, Woolcomber Street,
DOVER.

JAMES L. DIXON,
14, Suffolk Street,
(off Grafton St.), DUBLIN.

DIXON'S,
41, High Street,
DUNDEE.

DRAFFEN & JARVIE LTD.,
Nethergate,
DUNDEE.

CARTER'S STORES,
2, Terminus Buildings,
Tel. 953 EASTBOURNE.

BASSETT-LOWKE LTD.,
1, Frederick Street,
EDINBURGH.

WRIGHT'S DOLLS' HOSPITAL,
14, High Street,
ERDINGTON.

UPTON BROS. LTD.,
Sandgate Rd. and Tontine St.,
FOLKESTONE.

HARRY HUBBARD,
8, High Street,
(Opposite the Cricketers) GILLINGHAM.

ROBERT BALLANTINE,
103½, St. Vincent Street,
GLASGOW.

C. BELL (The Children's House),
320, Byres Road, Hillhead,
GLASGOW, W.2.

CLYDE MODEL DOCKYARD,
22-23, Argyll Arcade, GLASGOW.
Model Makers to the Admiralty, the Railway Coys., etc.

The MARVEL MART (Wm. Ross & Co.),
110, West Nile Street,
GLASGOW.

POLLOCK & CO., 36, Bridge St. and
222 and 245, Argyle Street
and 39, Paisley Rd. West, GLASGOW.

WELTON & MESSENT,
5, Pond Street,
HAMPSTEAD, N.W.3.

FLETCHER'S TOYLAND,
77, Deardengate, HASLINGDEN.
Grand Building, RAWTENSTALL.

HAMMOND'S LTD.,
Paragon Square,
HULL.

SMITH & DANIELS,
59, Westgate St., IPSWICH.
25, Market Place, GT. YARMOUTH

W. J. S. CARPENTER,
13 & 15, Queen Victoria Street,
LEEDS.

PEARSON & DENHAM (PHOTO)
LTD., 6, Bond Street,
LEEDS.

ROBOTHAM,
"Baby's Kingdom,"
Tel. 4809 LEICESTER.

LLOYD & SON,
2, Station Street,
LEWES.

BYCROFTS EMPORIUM,
366, High Street,
LINCOLN.

C. LUCAS, Hobbies Depôt,
35, Manchester Street,
LIVERPOOL.

Reliance Cycle & Motor Co.,
29/31, Manchester St., Liverpool.
Argyle & Conway Sts., Birkenhead.

Meccano & Hornby Train Supplies

The thirty-two dealers whose advertisements appear on this page carry full stocks of Meccano Outfits, Accessory Outfits and Meccano parts, Hornby Trains and Hornby Train Accessories all the year round. The names are arranged in alphabetical order of town.

The ARUNDEL CYCLE & SPORTS STORE, 52, Church Road, Upper Norwood, LONDON, S.E.19.

W. HUMPHRYS & SON, Estab. in 1840 269/271, Rye Lane, Peckham, LONDON.

F. R. POTTER & SON, 43, Market Place, LOUGHBOROUGH.

H. G. PARTRIDGE & CO., 10, Chapel Street, LUTON. Tel. 234

BARR'S CHILDREN'S PARADISE, 49, Deansgate, MANCHESTER. Tel. City 165

BAXENDALE & CO. LTD., Miller Street, MANCHESTER. Tel. 5900 City (20 lines)

A. FRANKS LTD., 95 & 97, Deansgate, MANCHESTER. 90, Bradshawgate, BOLTON.

A. INMAN, Moorfield Arcade, 105, Lapwing Lane, Didsbury, MANCHESTER.

EDWARD LLOYD, 268, Upper Chorlton Road, MANCHESTER, S.W. Tel. 613 Chorlton

JOHN NESBITT LTD., 42, Market Street, MANCHESTER.

H. WILES LTD., 124, Market Street, MANCHESTER.

SHAW'S BAZAARS, 30-36, High Street, MARGATE.

R. SCUPHAM & SONS, 35, Linthorpe Road, MIDDLESBROUGH.

DIBBS' DOLLIES' HOSPITAL, NELSON, LANCS.

ALFREDS, TOY SHOP, 77, Northumberland Street, NEWCASTLE-ON-TYNE.

WILLIAM OLLIFF, 13, Grainger Street West, NEWCASTLE-ON-TYNE.

THE OXFORD SPORTS DEPOT, 117, St. Aldates', OXFORD.

JANES & ADAMS, 13, The Promenade, And Branches. PALMERS GREEN.

A. J. ROBERTSON, 39-41, Broad Bridge Street, PETERBOROUGH. Tel. 374

R. MARSDEN & SON LTD., 115, Church Street, PRESTON. Tel. PRESTON 1314

DEAN & HOLT, 78, Yorkshire Street, ROCHDALE.

ROCHESTER. GERALD MORRIS, 24, High St., ROCHESTER.

SHEFFIELD PHOTO COMPANY, 6, Norfolk Row (Fargate), SHEFFIELD. 'Phone 3891

A. J. TINKER, 20, London Road, SHEFFIELD.

WILSON, GUMPERT & CO. LTD., 57, Fargate, SHEFFIELD. Tel. 489

BIRMINGHAM & COVENTRY CYCLE CO., 140 & 151, Above Bar, SOUTHAMPTON.

OSBORN & CO., 9, High Street, SOUTHAMPTON.

S. T. SIMPSON & SON, 589-595, Lord Street, SOUTHPORT. Tel. 999

H. W. GINN, The London Motor, Cycle & Sports Co., 106, High St., STAINES. Tel. 252 Staines

TAYLOR BROS., Great Underbank, STOCKPORT. Tel. 630

SAXONS LTD., 29/30, Holmeside, SUNDERLAND.

SPORTS HOUSE WOKING & WEYBRIDGE.

Mend your Punctures while you Ride

FORGET TYRE TROUBLE

and go care - free on your way. Tubes treated with our IMPERVO increase the joys of your Cycle.

"The Story of IMPERVO"

FREE

to Meccano Readers.

Write NOW for a Copy.

H. COLYER & CO. (Dept. 31a), 5, Point Hill, Greenwich, S.E.10.

GOLDFISH

Gold and Silver Fish 3d. to 5/- each.
Fancy Fish always in stock, including Golden Orfe, Catfish, Paradise Fish, Mirror Carp, Sunfish, etc., from 6d. each.
Vallisneria, 4d., Root Weed, 1/- Ble.
Snails, Food, Instructional Books, Rocks, etc. Aquariums from 3/6 each.
Over 10,000 Goldfish and Fancy Fish actually on view.
Send for complete Free Price List.

SPECIAL NEW YEAR OFFER.

A beautiful Cock Hartz Mountain Roller Canary on absolute full song, guaranteed, in Large New Canary Cage, Brass Top, Carriage Paid to your house 18/6.

Pet Animals and Foreign Birds.

DE VON & CO.,
127, King's Cross Road, London, W.C.1.
'Phone: Museum 0767.
Telegrams: "Oiseaux, Kincross, London."

THE WORLD'S GREATEST CYCLE OFFER

£10 FOR £6

The frame of the Graves **'Speed King'** Cycle is rust proofed, enamelled Black & Coach lined (or can be supplied all Black if desired) Fitted with

B.S.A. 3-SPEED GEAR
DUNLOP Roadster Cord Tyres
RENOLD CHAIN
MIDDLEMORE'S Three Coil Spring Saddle

Lady's or Gent's model same price, Carriage Paid. Terms: 8/- now, & 8/- monthly. Complete Approval

10 YEARS WARRANTY

£6:0:0

Catalogue Post Free. J. G. Graves Ltd. Sheffield.

BOYS! It is simply Top Hole!

The

CINEMA BOOK

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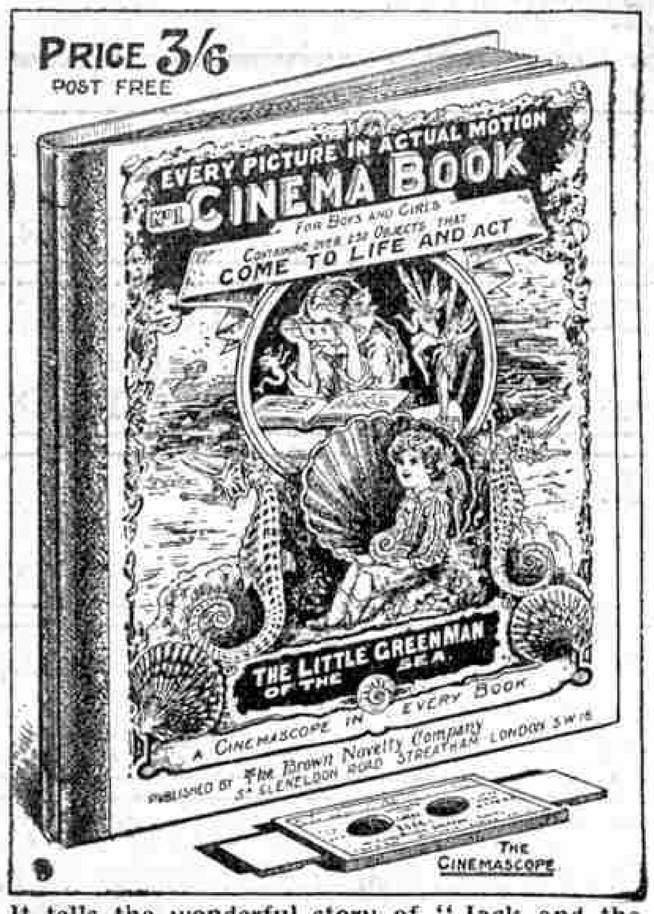

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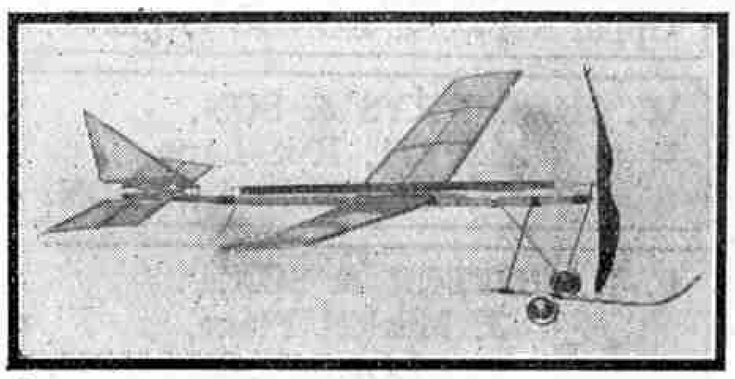

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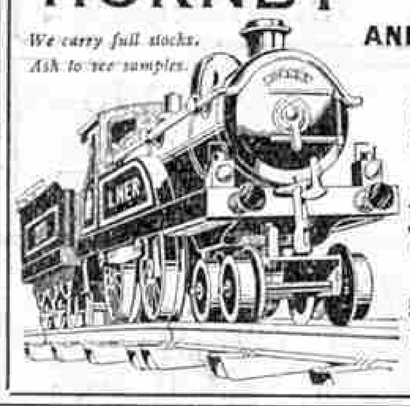

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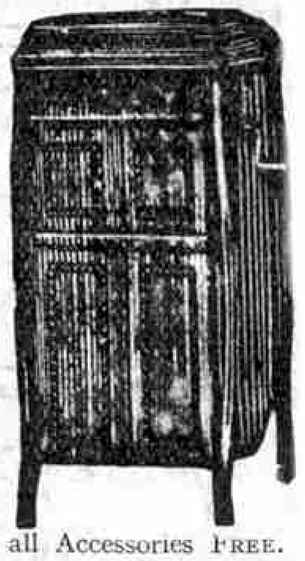

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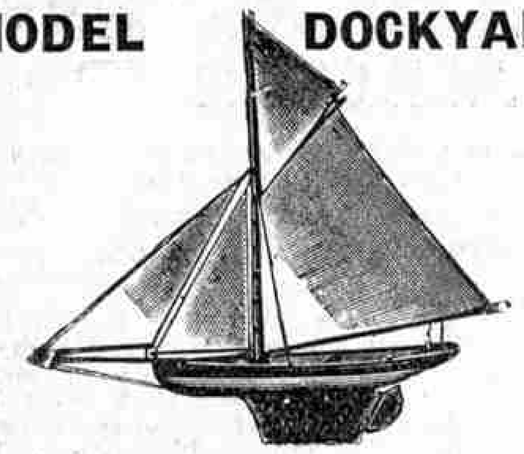

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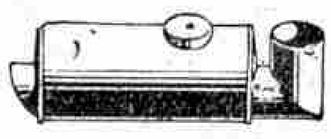

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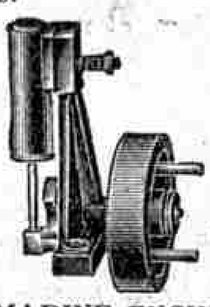

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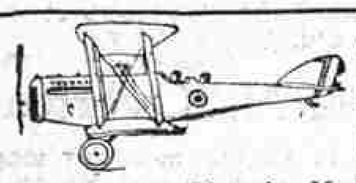

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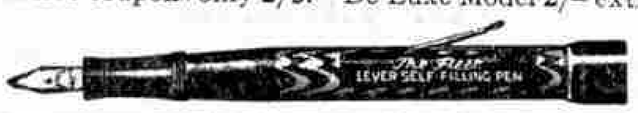

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To Contributors. The Editor will consider articles and photographs of general interest and payment will be made for those published. Whilst every care will be taken of articles, etc., submitted, the Editor cannot accept responsibility for any loss or damage. A stamped addressed envelope of the requisite size should be sent where the contribution is to be returned if unacceptable.

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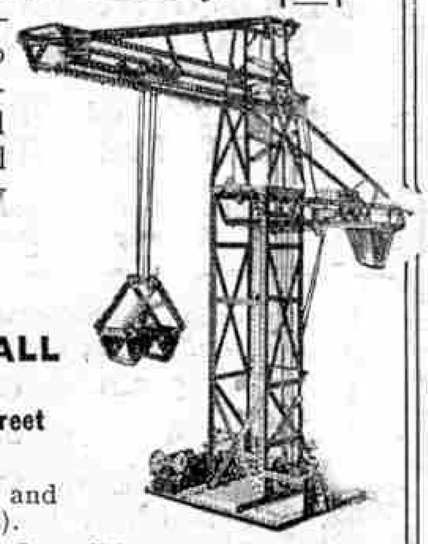
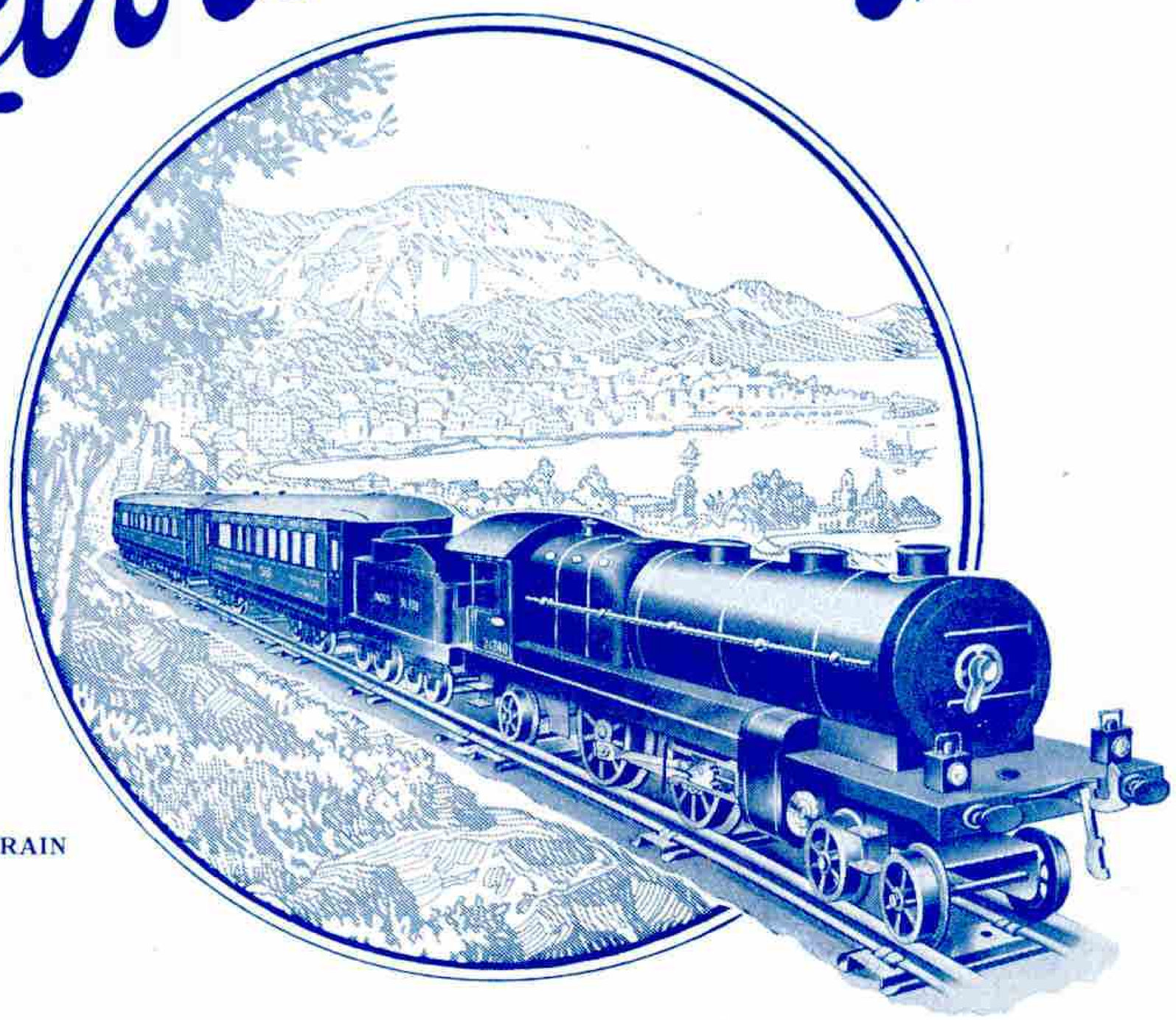


The Riviera "Blue" Train



THE
RIVIERA "BLUE" TRAIN

THE Riviera "Blue" Train, as the Calais-Mediterranean Express is familiarly called, runs between Calais and the Mediterranean Coast. Inaugurated to meet the requirements of wealthy passengers travelling from London to the fashionable French watering places, it is unequalled in the luxury of its accommodation.

The Coaches, the property of the International Sleeping-Car Company, are built of steel, wood being used for internal decorations only. The exteriors are elaborately finished with royal blue panelling with gold-leaf lining, hence the title of the train.

The "Blue" Train, introduced last year to the Hornby Series, is a model of this famous train. Distinguished in appearance, strongly built and beautifully finished in correct colours, it is supplied with either electric (4-volt) or clockwork loco.

RIVIERA "BLUE" TRAIN SET No. 1

contains Electric Loco, Tender, two Coaches, Resistance Controller and Electrical Rails to form a circle 4-ft. in diameter. The Loco is fitted with an electric motor which is operated from a 4-volt Accumulator or from a suitable transformer connected to the main (alternating current only). Gauge 0.

Riviera "Blue" Train Set No. 1, complete, well boxed Price	85/-
"Blue" Train Loco No. 1 ... ... "	37/6
"Blue" Train Coach No. 1 ... ... "	16/6
"Blue" Train Tender No. 1 ... ... "	4/6
Resistance Controller ... ... "	3/6

RIVIERA "BLUE" TRAIN SET No. 2

contains a powerful Clockwork Loco, Tender, two Coaches and set of rails including a Hornby Control Rail. The Loco is fitted for Hornby Control and has reversing gear and brake mechanism. Gauge 0.

Riviera "Blue" Train Set No. 2, complete, well boxed Price	70/-
"Blue" Train Loco, No. 2 ... ... "	27/6
"Blue" Train Tender No. 2 ... ... "	4/6
"Blue" Train Coach No. 2 ... ... "	16/6

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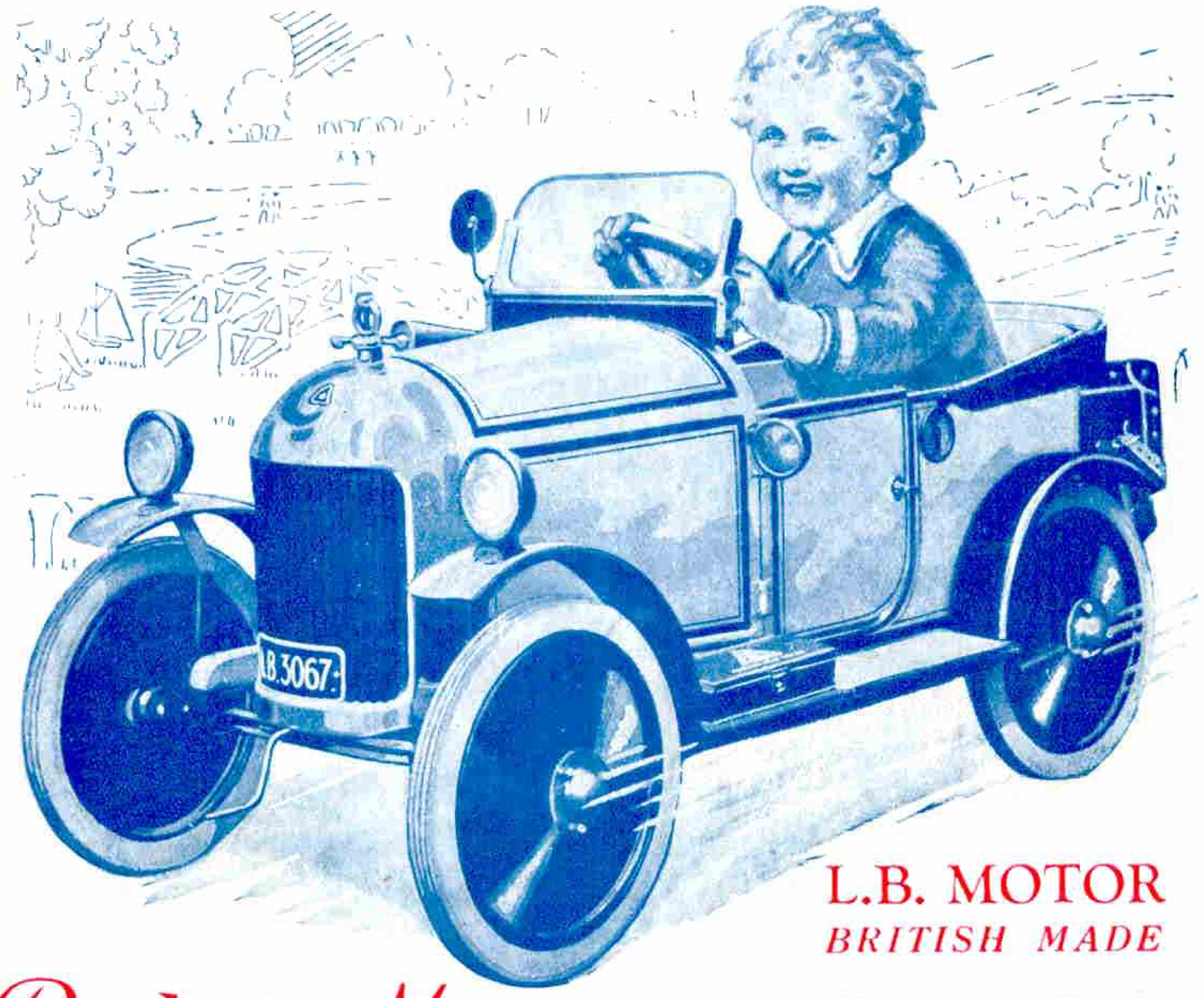

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Realistic Motoring for Boys & Girls

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The L.B. Motor as illustrated is the latest model and has a beautifully polished aluminium radiator, cycle chain drive, trunk, balloon cushion tyres, five lamps, tool box, detachable disc wheels, adjustable windscreen, etc. Price **£5.5.0**

PRINCE MOTOR. No. 7. Rolls Royce pattern motor. Can be had in dark blue, carmine, dove, suede, etc. Five lamps, luggage grid, four wheel brake sign, driving mirror, etc. included. Cycle chain drive, $\frac{7}{8}$" balloon cushion tyres, and detachable disc wheels. Length 40" overall. **£5.5.9**

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